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Life History Traits of the Threatened Purple Amole (*Chlorogalum Purpureum var. Purpureum*)

Fort Hunter Liggett, California

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ABSTRACT: Researchers monitored the threatened plant, purple amole (*Chlorogalum purpureum var. purpureum*) at Fort Hunter Liggett, California, from 1998 to 2004. The objectives of this research were to complete a statistical analysis of these data to evaluate: (1) demographics; (2) trends in population density; and (3) the relationship of purple amole to associated species, biological soil crusts, and disturbance. Overall, purple amole was most likely to flower and have greater seed production when it attained about 8 leaves or widths of 7 to 8 mm for its widest leaf, revealing a clear relationship between plant size and successful reproduction and seed set. Mortality and dormancy rates were estimated at 10 and 23 percent per year, respectively. Presumably, dormancy occurred, as mapped individuals were absent periodically throughout the monitoring. Density of purple amole was positively correlated with native species and presence of biological soil crusts; relationships to disturbance type were not apparent. Power analyses revealed that purple amole should be monitored at least 10 years to detect increases or decreases of 10 percent for mature plants (4 or more leaves). Due to greater variability, 10 to 20 years of monitoring are recommended to detect similar changes for 1 to 3-leaved plants.

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Conversion Factors

Non-SI* units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	(5/9) x (°F – 32)	degrees Celsius
degrees Fahrenheit	(5/9) x (°F – 32) + 273.15.	kelvins
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
horsepower (550 ft-lb force per second)	745.6999	watts
inches	0.0254	meters
kips per square foot	47.88026	kilopascals
kips per square inch	6.894757	megapascals
miles (U.S. statute)	1.609347	kilometers
pounds (force)	4.448222	newtons
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

*_Système International d'Unités_ ("International System of Measurement"), commonly known as the "metric system."

Preface

This study was conducted for the U.S. Army Environmental Center under Reimbursable project; D9450L, "Conservation Reserves and Partnerships — Statistical Analysis and review of Life History Characteristics of Purple Amole." The technical monitor was Steve Sekscienski, SFIM-AEC-TSR.

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was John A. Guretzky. Part of this work was done by Elizabeth R. Clark, and Darlene Woodbury, Fort Hunter Liggett. The technical editor was Gloria J. Wienke, Information Technology Laboratory. Alan B. Anderson is Chief, CEERD-CN-N, and Michael Golish is Acting Chief, CEERD-CN. The associated Technical Director was Dr. William D. Severinghaus, CEERD-CV-T. The Acting Director of CERL is Dr. Ilker Adiguzel.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

Purple amole (*Chlorogalum purpureum var. purpureum*), an endemic plant of the south coast ranges of California, has been determined to be a threatened plant by the U.S. Fish and Wildlife Service (USFWS 2000). Some remaining populations occur on Fort Hunter Liggett and Camp Roberts, lands owned and managed by the Department of the Army. Loss and alteration of habitat, destruction by construction and use of military training facilities, disturbance by military training activities, invasion of exotic annual grasses, alteration of fire regimes, and domestic livestock grazing are potential factors that threaten the remaining populations of purple amole (USFWS 2000).

Basic information about life history characteristics of purple amole and its relationship with associated plant species, soil biological crusts, and disturbance is required for development of endangered species management plans and assessing the viability of purple amole populations at Fort Hunter Liggett. In 1998, monitoring programs of purple amole were initiated at Fort Hunter Liggett to collect these data. Niceswanger (2001) completed an initial review of these data for the years 1998 through 2000. That research concluded that life history characteristics of purple amole were highly variable year to year due to dormancy and infrequent flowering and seed production.

Objective

The objectives of this research were to: (1) address the adequacy of data collected on life history characteristics of purple amole at Fort Hunter Liggett, CA, for development of a life history table and analysis of its population structure, growth, and decline; (2) conduct a power analysis to determine if the sample size is adequate to characterize the life history of purple amole and its relationship with other species, biological soil crusts, and disturbance; and (3) complete a statistical analysis of data collected through 2004, examining the relationship of purple amole to the presence/absence of associated species, plant community patterns, biological soil crusts, and disturbance. Results from these analyses should aid in management of purple

amole and development of a population dynamics (mortality, recruitment, and survivorship) study at Fort Hunter Liggett.

Approach

Personnel at Fort Hunter Liggett provided electronic forms of the databases and initial reports from monitoring studies conducted on purple amole populations at the installation to personnel at the Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) in Champaign, Illinois. The statistical analyses of the data and the summary and discussion of results were conducted in-house at ERDC/CERL.

Mode of Technology Transfer

A summary report with discussion of results from all statistical analyses, complete with tables and figures, accomplished in accordance with the objectives of this proposal will be provided to personnel at Fort Hunter Liggett. Included in this report will be a copy of the statistical analysis program and electronic copies of raw data and/or databases used in these analyses or intermediary calculations. The primary mode of tech transfer will be a report to the sponsor and publication as a U.S. Army ERDC-CERL technical report.

This report will be made accessible through the World Wide Web (WWW) at URL:
http://www.cecer.army.mil

2 Materials and Methods

Data collection

Niceswanger (2001) summarized data collection methods for purple amole at Fort Hunter Liggett. In 1998, biologists initiated monitoring programs on 23 sites of known occurrence of purple amole. At each site, 1-m^2 quadrats were placed every 2.5 m along a 50-m transect. Each quadrat consisted of four 0.25-m^2 sections. Within the first 0.25-m^2 section nearest the transect, a smaller 0.10-m^2 section was defined. The starting coordinate and azimuth of each transect were selected at random, and when facing the 50-m point from the 0-m point, the quadrats always occurred on the left side. Photographs were taken at each plot to aid in relocation and to preserve a visual record of the sites (Niceswanger 2001).

1998 Sampling

Data were collected in 1998 to describe (1) vegetation associates and their relative cover based on cover classes, (2) density of purple amole, and (3) life history characteristics of purple amole. Data on vegetation associates were gathered from sampling the 20 quadrats along each transect, starting at the 2.5-m point and continuing every 2.5 m through the 50-m point. All plants within the 0.1-m^2 sections were identified and assigned a relative cover class. The total cover could exceed 100 percent. Cover classes were assigned to native species, nonnative species, bare ground, litter, gopher disturbance, and evidence of pests. Occurrence and type of disturbance also were recorded for each of the 20, 1-m^2 quadrats. Human and animal-related disturbances were described and included these types: gopher, fire, foot trampling, vehicles, roads, and other animals. Density of purple amole was determined from counts conducted within the 20 1-m^2 quadrats.

To characterize life history traits, purple amole plants were mapped at the 0-m, 12.5-m, 25-m, and 37.5-m points. At least 10 plants were mapped starting in the 0.1-m^2 section nearest the transect. Mapping continued clockwise within the quadrat until 10 plants were recorded. If it took more than one 0.1-m^2 section to record 10 plants then all plants in the additional sections were recorded. All plants within the sections sampled were mapped so that it was possible to determine in subsequent sampling years if plants present were the same individuals previously recorded, new recruits, or plants that were dormant the previous seasons. Each

mapped plant was recorded on a grid and given a number. The number of leaves, flowering status, number of branches on the flowering stem, and evidence of herbivory or disturbance was recorded.

1999 Sampling

Sampling in 1999 was similar to that of 1998 with the exception that data were not collected on associated species. Also, one additional quadrat was added along each transect by sampling from the 49-m point to the 50-m point, making the total number of quadrats per plot 21 instead of 20.

2000 Sampling

The number of visits to each plot increased to four per year in 2000 to gather data on the seasonal life cycle of purple amole (Niceswanger 2001). Plots were sampled one time per year in 1998 and 1999. Beginning in 2000, sampling occurred (1) early in the season to record emerging seedlings, (2) mid-way through flowering, (3) late-cycle after capsule formation, and (4) at the end of season to count the number of seeds produced by each plant. Also in 2000, sampling was expanded to all 0.25-m^2 sections within the original 1-m^2 quadrats to increase the total number of plants mapped in the study. If no additional plants were found within the 1-m^2 area, the quadrats were rotated around the sampling location in 90 degree turns until plants were located. Due to the scattered clumping of purple amole it was possible that zero plants were recorded at some sampling points. Furthermore, plants were mapped at the 50-m point beginning in 2000.

During the early sampling period, the number of leaves, width of widest leaf, presence of a flowering stalk, or presence of flowers were recorded for each individual plant, whether first mapped in 1998, a new seedling, or a previously unrecorded, possibly dormant plant.

Sampling at the mid-season/flower formation period occurred at the peak of the flowering cycle. All flowers that were observed open were counted; closed flowers or buds were not counted. Flowers that were withered or where it could be determined that a pedicel had fallen off of the stalk also were recorded. Capsules that were formed at this point were recorded but were a separate count from flowers. If a flower had a visible green swelling that had begun to develop seeds at the base of the flower a 'capsule' was recorded instead of a 'flower.' Small, soft immature ovaries were counted as flowers. It was not possible to observe every plant in its maximum development because plants continued to flower and terminal buds continued to develop when conditions were favorable. During observation of the flowering

status, researchers noted that some plants aborted mid-development causing developing buds, flowers, and capsules to wither.

During the end of season/capsule formation sampling period, the total number of capsules present was recorded. If capsules were visibly withered or looked dead, they were recorded in a separate category. Each capsule was counted only once and recorded in one of the categories. Some plants still had open flowers at this point and these were recorded.

Seeds present were recorded during the last sampling period. At this time, the seeds sit within opened capsules before dispersal by wind or other disturbance. If empty capsules were present, estimates of seed number were made through assessment of the shape of the capsule. Seeds were large and each section of the ovule housed either one or two seeds. After looking at many capsules with seeds intact surveyors were able to make an accurate estimation of the number of seeds produced by a capsule even when seeds were absent. Sections with only one seed tended to be flatter and broke open more completely. Sections with two seeds were more deeply cupped and remained in a cup shape even after seeds were dispersed. Attempts to sample seeds by placing teabags on the capsules while they still were attached to the plant were unsuccessful as rodents frequently pulled off the bags before observers counted the seeds.

Analysis Methods

Niceswanger (2001) reported data on age cohorts, seeds and seedlings, dormancy, and reproductive success of purple amole and the effects of disturbance for the monitoring years 1998, 1999, and 2000. Mean responses for these variables were determined by averaging individual plant or quadrat data across all plants or quadrats mapped among the 23 sampling sites. Variability associated with these means, however, was not reported, and the calculation of mean responses across all plants or quadrats ignored the plot structure from which the data were collected. Quadrats along transects or individual plants within transects did not represent independent samples (in reference to Hulbert 1987). We determined population means ± the standard error or standard deviation by first averaging data for individual plants or quadrats within a transect and then calculating mean responses across the 23 transects (replications) and/or 7 years (1998 to 2004) or 5 years (2000 to 2004), depending on the response variable. The data were analyzed with SYSTAT (SYSTAT Software, Inc., Richmond, CA). Descriptive statistics were calculated to answer questions about basic life history traits, vegetation associates, and density of purple amole according to the study objectives.

A power analysis was conducted to determine the ability of the monitoring program to detect upward or downward trends of purple amole abundance through time using linear regression. The analysis was conducted using the TRENDS software program (Gerrodette 1993) accessed online at: http://swfsc.nmfs.noaa.gov/PRD/software/Trends.html (verified 28 June 2005). A trend is detected when a regression has a slope significantly different than zero. A conclusion that a trend has occurred (significant increase or decrease) when in fact it hadn't, is termed a Type I error. A Type II error refers to the conclusion that no trend occurred (no increase or decrease), when in fact one did. The probabilities of making Type I and II errors are labeled α and β, respectively. Statistical power is the probability of rejecting a false null hypothesis (a hypothesis of no trend) when indeed, it is false (a trend did occur). Power is labeled as $1 - \beta$. Estimation of power is possible given the number of samples (n), estimates of sample variability (CV), and rates of change $|r|$ (Gerrodette 1987). Power of 0.8 generally is necessary to detect significant trends when they occur.

Data Analyzed

Flowering

Nonlinear regression analyses were conducted to determine the relationship of flowering of purple amole with leaf number and width of the widest leaf, respectively. Data for plants mapped for years 2000 to 2004 were used in these analyses. Means and standard errors for the probability of flowering were determined for each leaf number and leaf width category (Appendix A: Flowering of Purple Amole, page 28). The nonlinear regression analyses were conducted using data for each leaf number or leaf width category where the number of plot means (N) was greater than 1. A correlation analysis was used to detect a relationship between leaf number and leaf width.

The relationship between the presence of mapped plants, reproductive status, and precipitation were determined using correlation analysis for the years 1998 to 2004 (Appendix B: Presence of Purple Amole, page 30).

Dormancy

The proportion of plants exhibiting dormancy and the probability of dormancy in a given year was determined for years 1998 to 2004 (Appendix C: Dormancy of Purple Amole, page 35). Of plants that showed dormancy, the total years they were dormant, average length of dormancy, and whether they were reproductive following a dormant year was determined.

Whether or not a plant was dormant or absent due to death or other unknown circumstance was difficult to determine. Therefore we assumed a plant was dormant:

1. If present 0 years between 2000 and 2004, the plant was assumed dead regardless of the number of leaves.
2. If present 1 year only in 2000 or 2001 and absent in 2002, 2003, and 2004, the plant was assumed dead regardless of the number of leaves.
3. If absent in 2003, 2004, or both, but present in 2002, the plants were not considered dead or dormant.
4. If present in 1 year only, regardless of whether that was 2001, 2002, 2003, or 2004, plants with < 4 leaves were considered new plants or seedlings. Plants with ≥ 4 leaves were assumed to have exhibited dormancy for 1 year before the current year.
5. If present 2 or more years, plants were considered to have exhibited dormancy when years where they were present were split by years where they were absent.
6. Absence in 1999 was not considered as a dormant year.
7. Plants mapped in 1998 that were found after 2000 were certainly considered to have exhibited dormancy.

Seed Production

The proportion of flowering plants that produced seed was determined by year of sampling and leaf number for years 2000 to 2004 (Appendix D: Seed Production for Purple Amole, page 37). Histograms were generated to show the proportion of flowering plants producing seed within the plots for years 2000 to 2004. Correlation analyses were conducted to examine the relationship between the proportion of flowering plants that produced seed and the proportion of plants that flowered.

Persistence

To examine whether plants mapped in 1998 and 2000 were still alive and determine the average number of years lived, means were determined across leaf number (Appendix E: Persistence of Purple Amole, page 47). A correlation analysis was conducted to examine the relationship between persistence (percentage still living and years lived) with leaf number. Plants for which no data was collected in 2004 were not included in the analyses.

Disturbance, Density, and Vegetation Associates

The density of purple amole in nonmapped quadrats was examined in relation to cover of vegetation associates and presence of disturbance using correlation analy-

ses. Mean determined by plots and years are located in Appendix F: Disturbance, Density, and Vegetation Associates for Purple Amole, page 63.

Power to Detect Trends in Population Density

Power analyses were conducted to determine the probability of detecting upward or downward trends in abundance of purple amole provided a given number of sample years (n), estimates of sample variability (CV), and a projected rate of change $|r|$. This analysis was completed using data from mapped purple amole plants with 1 to 3 and 4 to 8 leaves. First, the mean across plots of the sum of mapped purple amole plants by plot was determined for each year and leaf number category (Appendix G: Sum of Mapped Purple Amole Plants by Plot, page 73). The coefficient of variation was determined by dividing the standard error of regression by the mean purple amole abundance across years for the two leaf categories. Since transects were used to estimate abundance of purple amole, the CV was assumed proportional to $1 / \sqrt{\text{abundance}}$ (as noted in Gerrodette 1987). The CV was then used in the TRENDS program with various rates of positive and negative change $|r|$, number of years to monitor the population ($n = 5$, 10, and 20), and linear and exponential models of change.

3 Results and Discussion

Flowering

Flowering status of purple amole was related to its number of leaves and width of its widest leaf. Purple amole was most likely to flower when it attained approximately 8 leaves (Figure 1)* or widths of 7 to 8 mm for its widest leaf (Figure 1). A correlation ($r = 0.75$) also showed that the width of the widest leaf and the number of leaves were positively related ($P \leq 0.001$).

Niceswanger (2001) divided immature and mature plants based on the number of leaves. Plants with 1 to 3 leaves were considered nonreproductive, and plants with ≥ 4 leaves as reproductive adults. Of plants present from 2000 to 2004, 1-leafed individuals represented from 7 to 15 percent (Table 1).† Plants with greater than or equal to 4 leaves represented 41 to 60 percent of the plants in those years (Table 1).

The percentage of mapped purple amole plants that were present in any given year from 1998 to 2004 and the percentage of those present that were reproductive and vegetative did not show a significant relationship to the percentage of average precipitation from 1960 to 2003 (Table 2). However, a positive correlation ($r = 0.72$) existed between the percentage of plants present that flowered and total precipitation for February and December through March for the mapped plants in 1998 to 2004 (Figure 2).

The percentage of plants reproductive ranged from a low of 13 percent in 2002 to a high of 63 percent in 2000 (Table 2). These results contrasted with those of Niceswanger (2001) who showed that in 2000 only 26 percent were reproductive. These anomalies were likely the result of Niceswanger (2001) computing average reproductive rates across all plants within the study versus the methods employed here where means were computed across plots.

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* Figures are at the end of the text, beginning on page 15.

† Tables are after the figures, beginning on page 24.

Dormancy

Purple amole plants not present often are dormant. Of plants mapped from 1998 through 2004, 23 ± 2.9 percent have exhibited dormancy. Dormancy may last for more than 1 successive year. Among the mapped purple amole plants, maximum dormant periods have extended up to 4 years. The average length of the period for those plants that have exhibited dormancy, however, has been 1.4 ± 0.13 years. The mean total number of years a plant has been dormant, thus far, in the 7 years of this study also has been 1.4 ± 0.13 years. This value is expected to increase as the number of monitoring years increases.

In any given year, the probability that a plant would exhibit dormancy was 0.06 ± 0.010. Furthermore, plants can be dormant for 1 or more years and be reproductive the following year. The percentage of plants that flowered in the year following a dormant year was 6.4 ± 4.7 percent.

Seed Production

The proportion of flowering plants that produced seed was affected by the year of sampling and leaf number (Figure 3). The percentage of flowering purple amole plants producing seeds was greatest in years 2001 and 2003 and least in 2002 and 2004. In the high seed producing years, 2000 and 2003, the proportion of flowering plants producing seed was greater for plants with more leaves. In the low seed producing years, 2002 and 2004, the proportion of flowering plants producing seed was similar among plants with 4 leaves as those with 8 or 10 leaves. Therefore, the proportion of flowering plants producing seed is greater for more mature plants in good seed producing years but similar among plants regardless of leaf number in low seed producing years.

Seed production by flowering plants was not normally distributed among the sites or plots (Figure 4). In 2000, the proportion of flowering plants producing seed was less than 30 percent in 7 plots, between 30 and 80 percent in 7 plots, and greater than 90 percent in 4 plots. Contrasting in 2001, the proportion of flowering plants producing seeds was greater than 70 percent in 10 plots, between 40 and 70 percent in 7 plots, and less than 30 percent in 3 plots. Similar results occurred in 2003 with the proportion of flowering plants producing seeds being greater than 70 percent in 11 plots, between 40 and 70 percent in 4 plots, and less than 30 percent in 3 plots. Distributions opposite to that of 2001 and 2003 occurred in 2002 and 2004 as the proportion of flowering plants producing seeds was less than 30 percent in 9 plots in 2002 and 8 plots in 2004.

The relationship between the proportion of plants that flowered and the proportion of flowering plants that produced seeds was not particularly strong when individual plant responses were averaged by plot and year (Figure 5A). This shows that factors affecting the response in terms of flower production may differ from those affecting the production of seeds when considered on a plot-by-plot basis. When the relationship between flowering and seed production was considered on the basis of leaf-number or plant size and the individual responses of plants were averaged first by plot and then across plots (Figure 5B), the relationship between flowering and seed production improved. Therefore, the factors affecting flowering and seed production are strongly correlated when size of the plant is considered and by reducing variability across plots.

The number of seeds produced per flowering plant was directly related to its number of leaves (Figure 6). The number of seeds produced per flowering plant also varied with year ranging from lows of 6 seeds per flowering plant in 2002 and 2004 to a high of 17 per plant in 2003 (Table 3).

Persistence

Of the original 1-leafed plants, 34 ± 16.7 percent of those mapped in 1998 and 91 ± 5.8 percent of those mapped in 2000 or later were still alive in 2004 (Table 4). Persistence of these 1-leafed plants has averaged 3.0 ± 0.99 years for plants mapped in 1998 and 2.6 ± 0.18 years for plants mapped in 2000 or later.

A correlation analysis revealed that the percentage of mapped purple amole plants still living and their years lived might be negatively related to the size of these plants when mapped. For plants mapped in 1998 (Figure 7A), the percentage of plants still living and the number of years lived was not significantly related to the number of leaves. For plants mapped in 2000 (Figure 7B), however, the percentage of plants still living in 2004 was negatively correlated with the number of leaves ($P \leq 0.001$; $r = -0.32$); the relationship between the number of years lived and number of leaves was not significant.

The probability of mortality of a plant in any given year was not related to the number of leaves (Figure 8) and averaged = 0.104 ± 0.027.

Disturbance, Density, and Vegetation Associates

The density of purple amole generally was similar among most plots, being less than 10 plants per nonmapped quadrat (Figure 9). A few plots consistently had a

greater density, however. Plots 6, 7, 8, and 14 had densities that ranged from 8 to 32, 9 to 18, 22 to 76, and 21 to 37 plants, respectively, among the years sampled (see Appendix F, page 63, for raw data). Variability generally increased with the plot mean (Figure 9). When means were determined by year and across plots, density ranged from 4 to 8 plants per quadrat, being greater in 2001 and 2003 than 2000 and 2002 (Figure 10).

The percentage of nonmapped quadrats disturbed each year ranged from a low of 39 percent in 2000 to a high of 68 percent in 2002 (Table 5). Gophers generated most of the disturbance in all years. Human-related disturbances were low compared to animal disturbances. However, 13 percent of the quadrats were disturbed by fire in 2002 (Table 5). Disturbance from animals and the sum of animal and human disturbances were not correlated with density or a change in density of purple amole in the nonmapped quadrats (Table 6). An increase in human and fire (human-related) disturbances, however, was associated with a reduction in density of purple amole from one year to the next in the nonmapped quadrats ($P \leq 0.001$; $r = -0.41$ and $r = -0.44$, respectively).

Averaged across plots and years (Table 7), mean cover of total herbaceous species was 67.0 ± 1.88 percent. Of this cover, 20.7 ± 1.32 percent was native species and 50.5 ± 2.53 percent was nonnative species. The percentage of cover consisting of bare ground was 25.5 ± 2.21percent. Disturbances from gophers and pests covered 6.2 ± 0.67 and 4.2 ± 0.40 percent, respectively. Biological soil crusts occurred in 50 ± 3.7 percent of the plots.

Density of purple amole was examined in relation to the cover of these vegetation associates using correlation analysis (Table 8). A significant positive correlation ($P \leq 0.05$) was found between the density of purple amole and cover of native species ($r = 0.199$) and presence of biological soil crusts ($r = 0.271$).

Power to Detect Trends in Population Density

The power to detect a significant positive or negative trend in purple amole abundance depended on the size of the plant or number of leaves. Greater variability from year to year existed in the initial values for mean population density for plants of 1 to 3 leaves than plants with 4 to 8 leaves (CV = 0.30 and 0.18, respectively). Therefore, power to detect a significant trend in mean population density, whether positive or negative, was greater for plants with 4 to 8 leaves. The ability to detect this trend depended on the rate of change to detect (r), the number of years the plants were monitored (n), and whether the population was expected to increase or decrease at linear or exponential rates.

For plants with 1 to 3 leaves (Figure 11), the ability to detect an increase of 10 percent (r = 0.1) was relatively low when the number of years the population was monitored equaled 10 or less, regardless of whether the population increased at linear or exponential rates (Power ≤ 0.3 and 0.6, respectively). The ability to detect a decrease of 10 percent was much greater, power≥ 0.9 for both linear and exponential models. The power to detect a significant trend increased as the number of years the population was monitored increased. If a population is monitored for 20 years, the power to detect an increase or decrease of 5 percent or more ($r \geq 0.05$) was generally strong when the population increased or decreased at exponential rates (Power = 0.9 and 1.0, respectively). For linear models of change, power was strong to detect negative trends (Power = 1.0) but was lower for positive trends (Power ≤ 0.6).

For plants with 4 to 8 leaves (Figure 12), significant power existed to detect negative and positive trends of 2.5 percent if the population was monitored for at least 20 years. A decreasing trend of 5 percent for linear and exponential models was detectable after 10 years of monitoring. Power to detect increasing trends after 10 years of monitoring depended on whether the trend was linear or exponential. For the exponential model, an increasing trend of about 8 percent was detectable after 10 years of monitoring. For the linear model, the minimum rate of positive change that could be detected with good power if the population was monitored for 20 years was 20 percent (r = 0.20). If the population was monitored for only 5 years, power only was sufficient to detect 20 percent declines in population density, remaining too low to detect positive trends in population density.

4 Conclusions

1. The nonlinear relationship between flowering of purple amole and the number of leaves and width of the widest leaf and the close relationship between the number of seeds produced and the number of leaves demonstrated that reproduction and seed set in purple amole is closely related to plant size or maturity.
2. Purple amole often exhibits dormancy. Periods where aboveground structures are not produced often exceed more than 1 year and through 2004, have been shown to extend at least to 4 years.
3. Surprisingly, the number of years a plant lives was not closely related to its number of leaves it last had before it was presumed dead. Mortality rate per year was estimated at 10 percent within the population.
4. Clear relationships between density or abundance of purple amole and disturbance, disturbance type, and vegetation associates also were not apparent. Gophers generated the most disturbance within the plots but presence of their disturbances was not correlated with density of purple amole. Positive correlations of purple amole and cover of native plant species and presence of biological soil crusts may suggest mutualism between these factors.
5. Power analyses revealed that for mature plants, with 4 to 8 leaves, populations should be monitored a minimum of ten years to detect significantly ($P \leq 0.05$) increases or decreases in population density at 10 percent rates of change. To detect population changes at rates of 5 percent or less requires monitoring between 10 to 20 years. For 1 to 3-leaved purple amole plants, ~ 15 years of monitoring is required to detect 10 percent density increases and ~ 10 years of monitoring is required to detect 10 percent decreases of density. To detect increases or decreases of 1 to 3 leaved plants at rates of 5 percent requires at least 20 years of population monitoring.

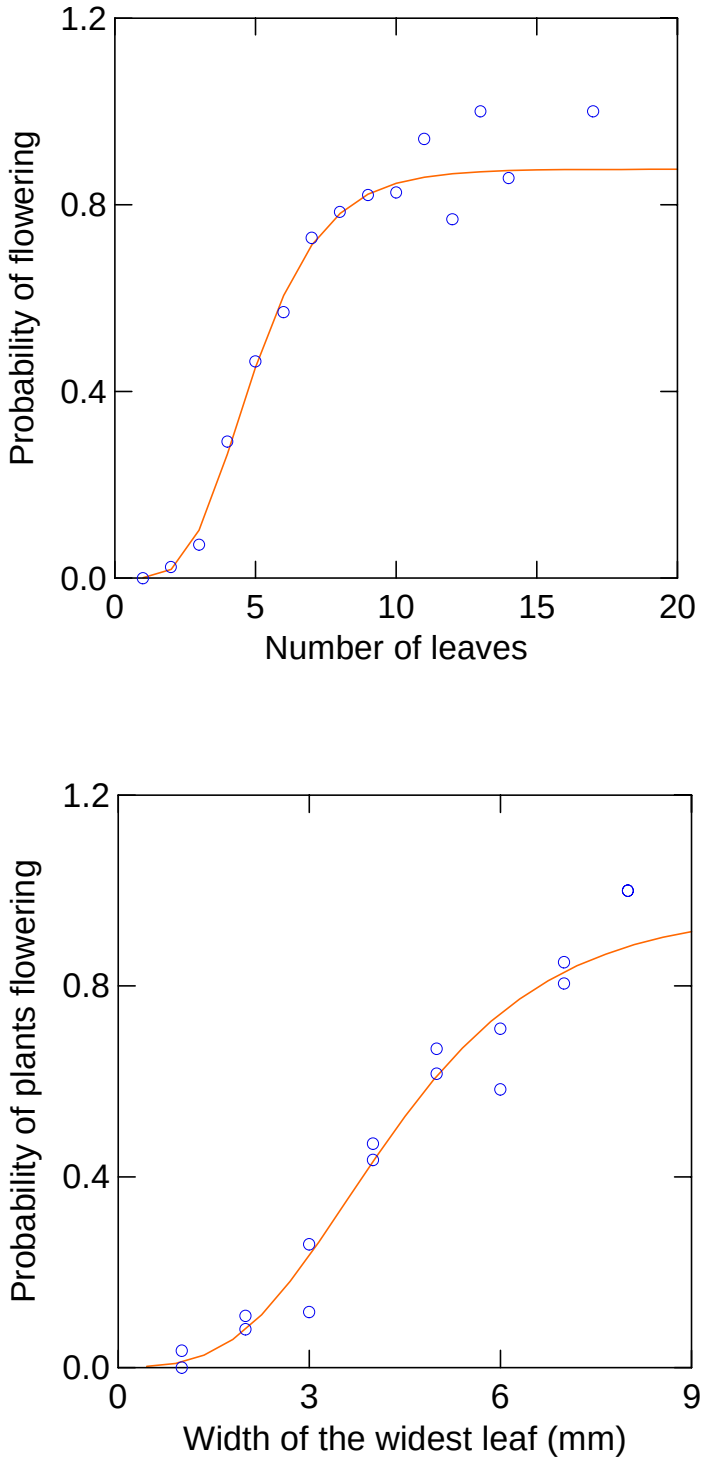


Figure 1. Probability of flowering for purple amole in a given year.
Upper: in relation to the number of leaves and Lower: in relation to the width of the widest leaf.
Values represent means determined across plots and years.

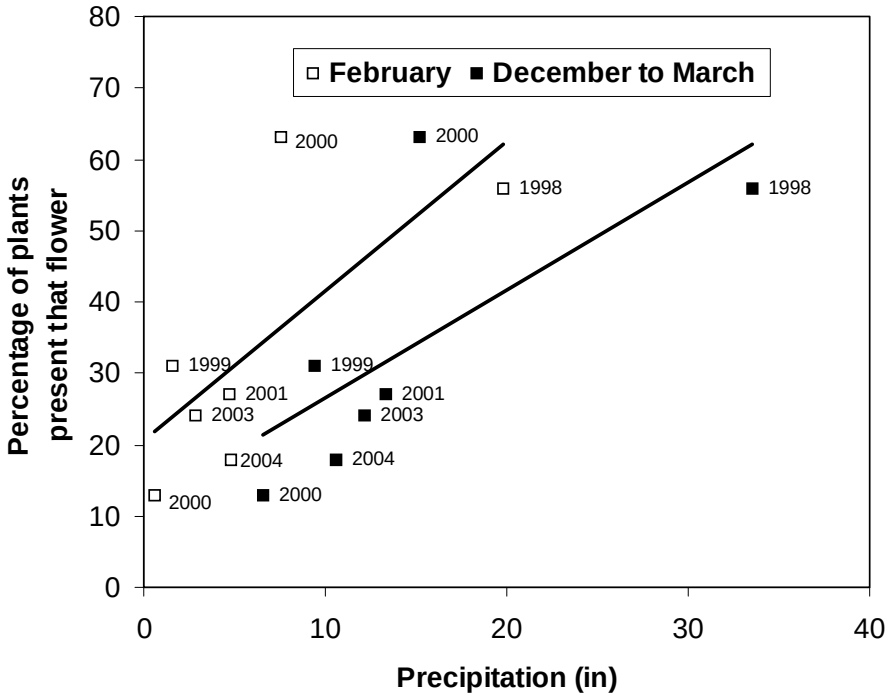


Figure 2. Positive correlations (r) between the percentages of plants present that flowered and precipitation totals for February and December through March in years 1998 to 2004

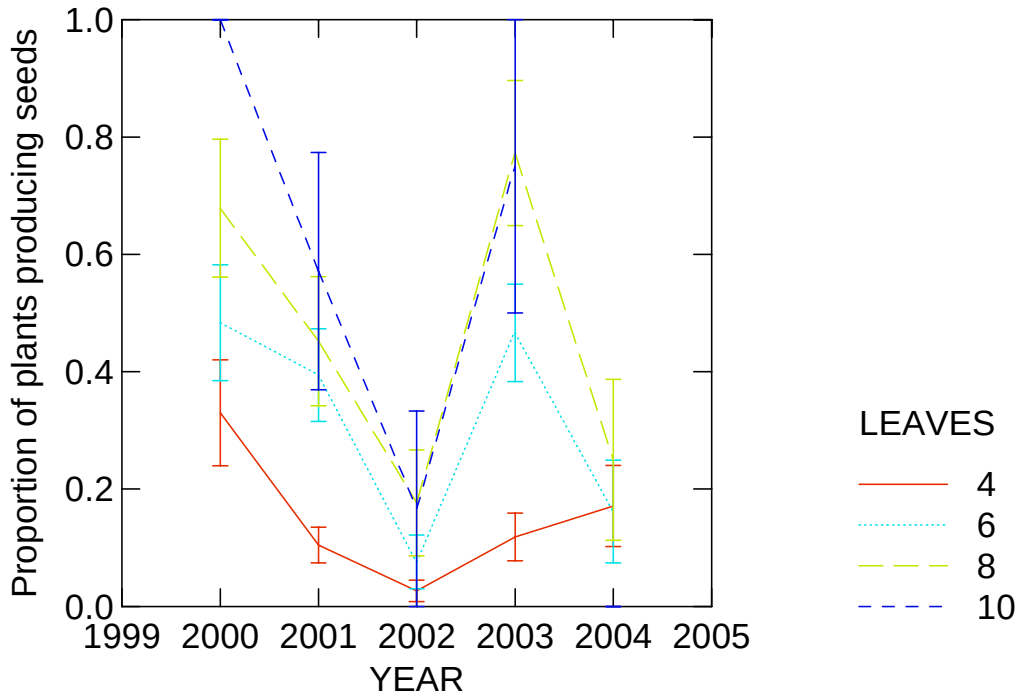


Figure 3. The proportion of flowering plants producing seed by leaf number and year. Means and standard errors were determined across plots.

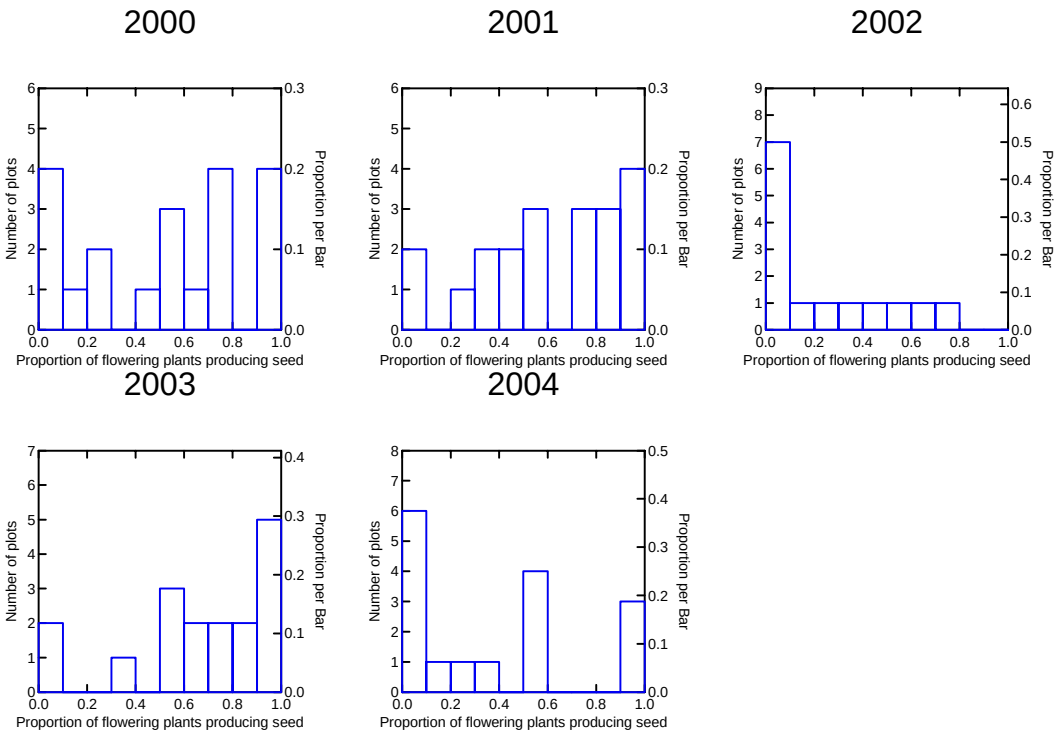


Figure 4. Nonnormal distribution of the proportion of flowering plants that produced seed among plots from 2000 to 2004.

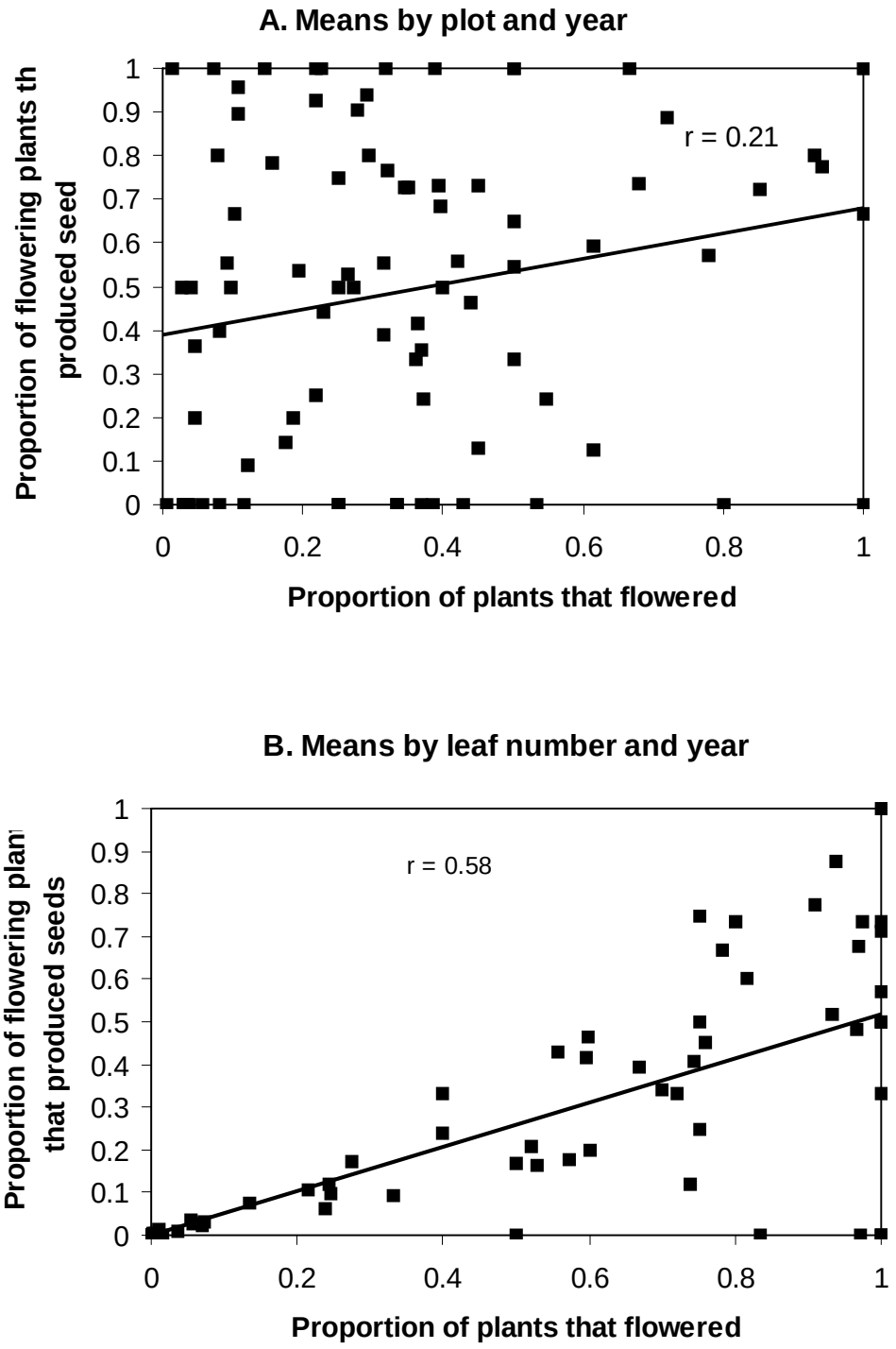


Figure 5. Relationship between the proportion of plants that flowered and the proportion of flowering plants that produced seeds.
Means were determined by averaging individual plant data by A) plot and year and B) leaf number and year.

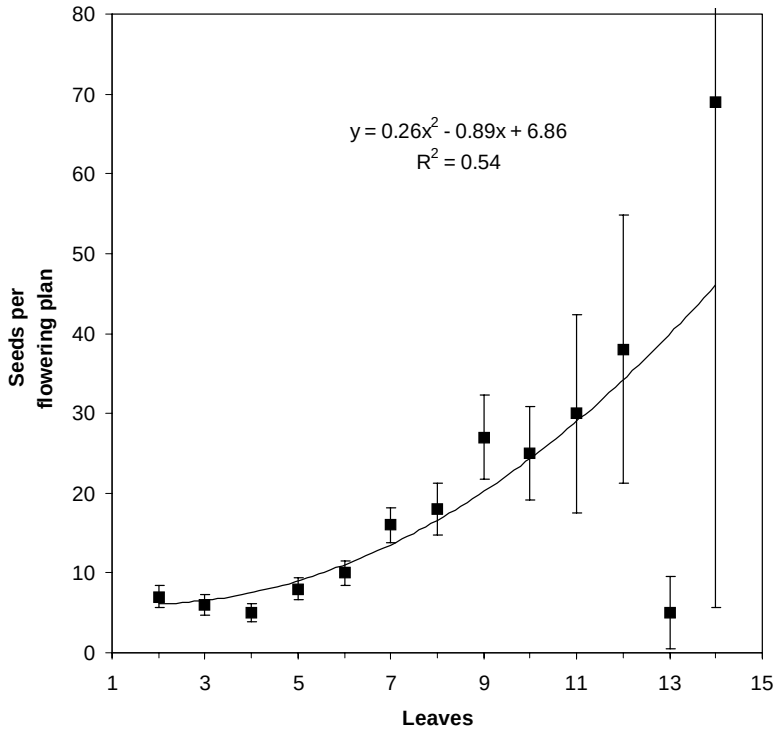
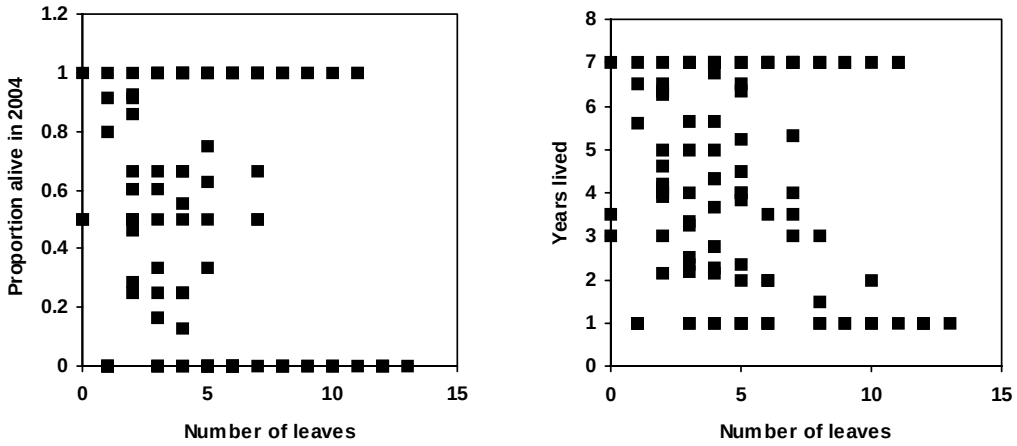


Figure 6. Seed production per plant in relation to the number of leaves. Values represent means and standard errors across plots and year.

A. Plants mapped in 1998



B. Plants mapped in 2000

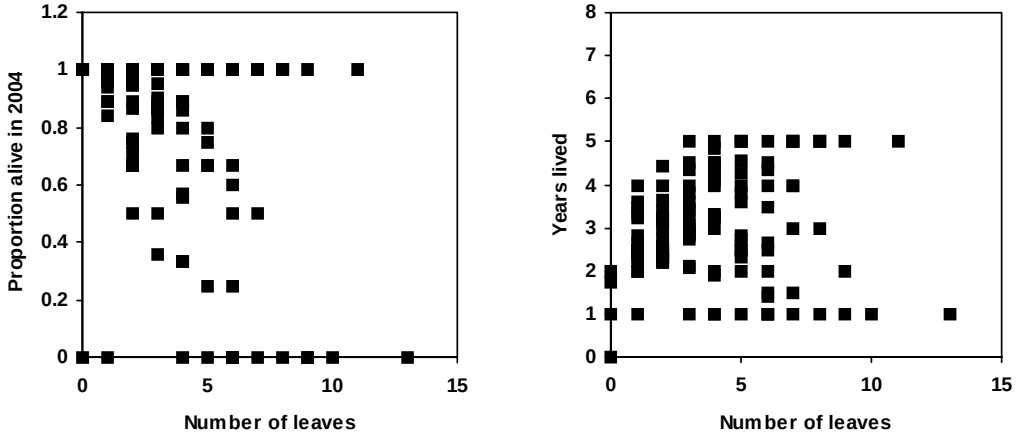


Figure 7. Relationship between the percentage of plants still living in 2004 and the years lived with that of leaf number.

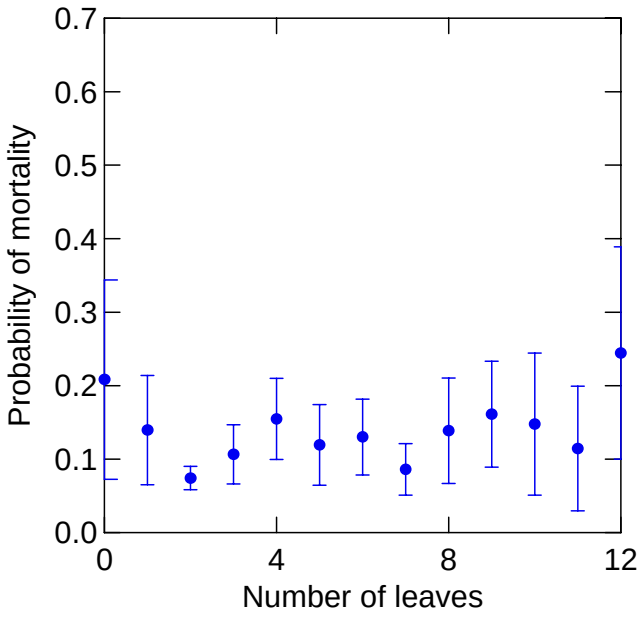


Figure 8. Probability of mortality in any given year for purple amole in relation to its number of leaves.

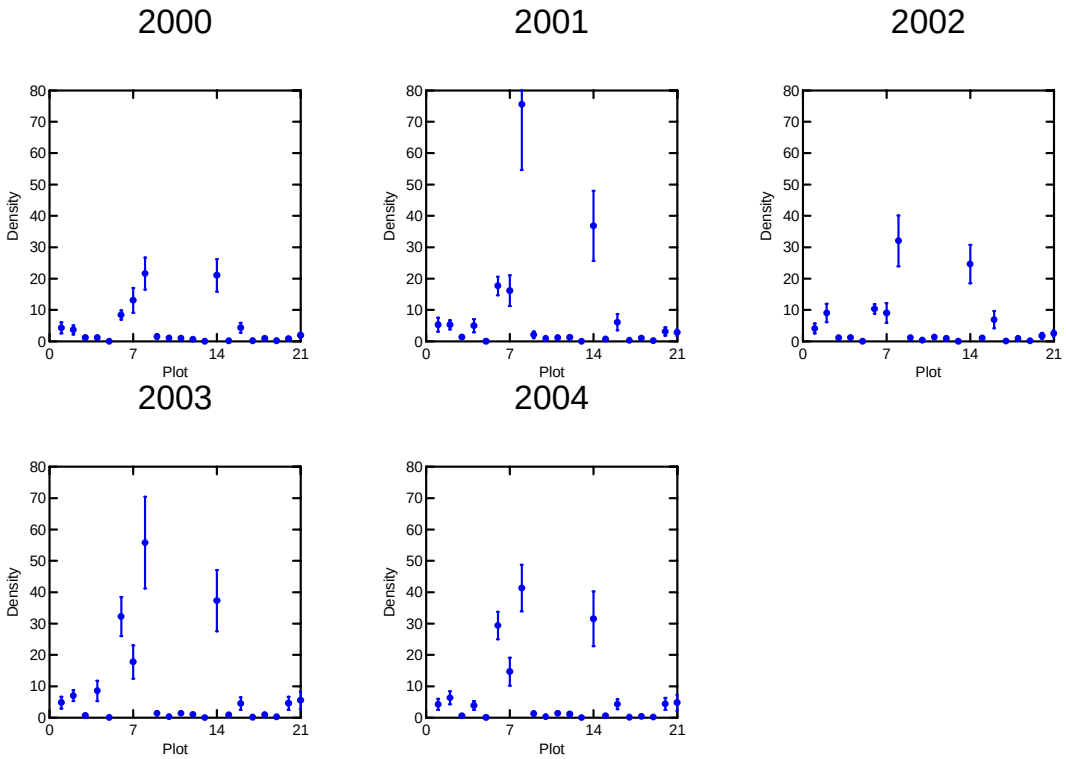


Figure 9. Density of purple amole in nonmapped quadrats by years.
Values represent means determined across quadrats occurring within a plot ± standard error of the mean.

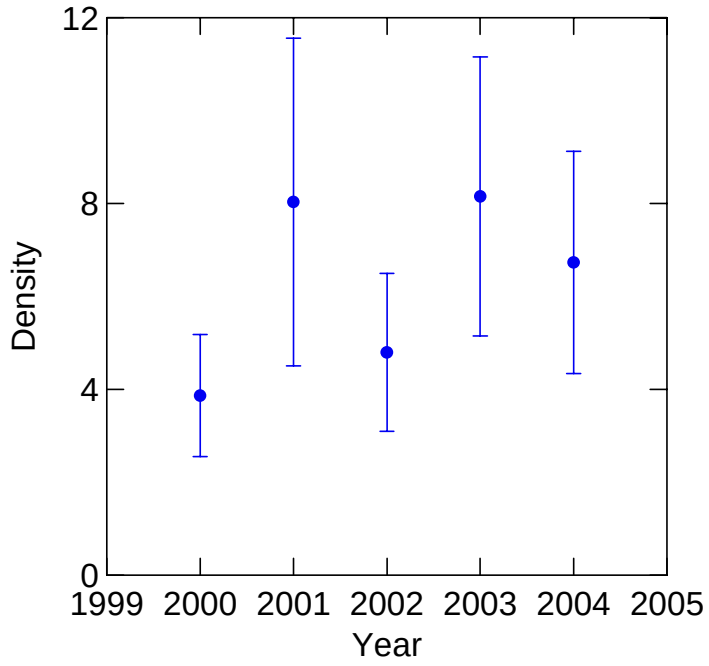


Figure 10. Density of purple amole in nonmapped quadrats.
Values represent means determined across plots by year ± standard error of the mean.

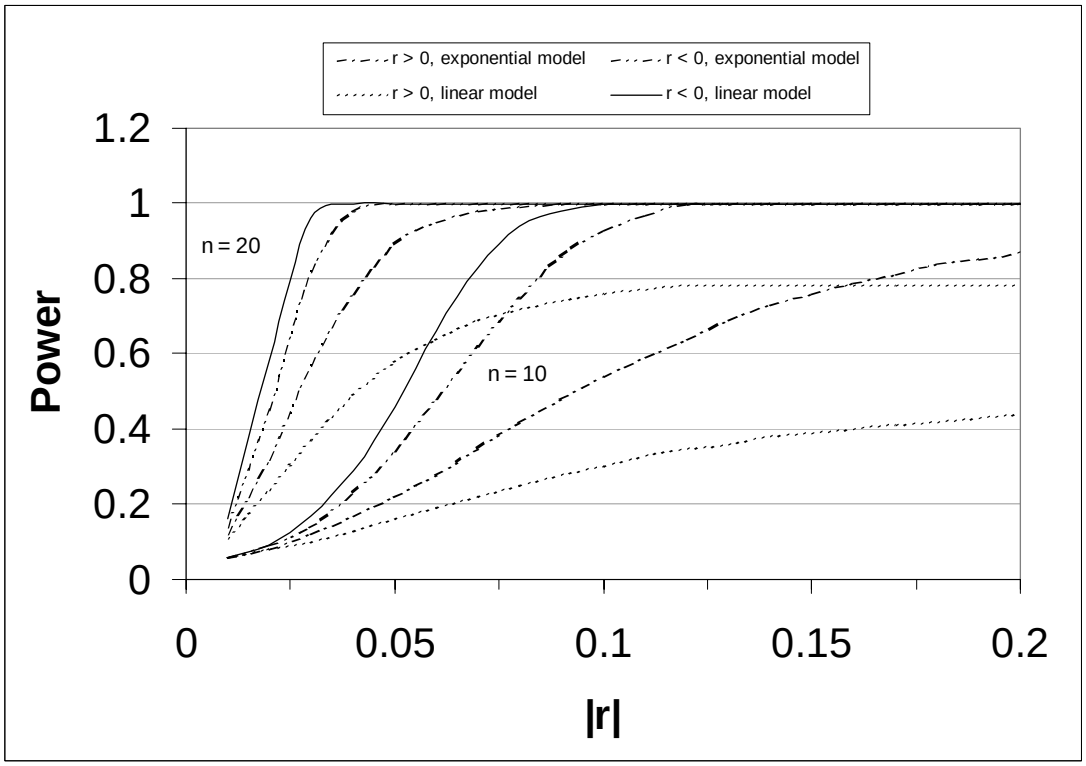


Figure 11. Power to detect a change in population density for 1- to 3-leaved plants as a function of the number of years monitored (n), rate of population change (r > 0 or < 0), and linear vs. exponential models of change.
Curves shown use a model with the assumption that CV is proportional to 1/√density, with CV = 0.3 and α = 0.05.

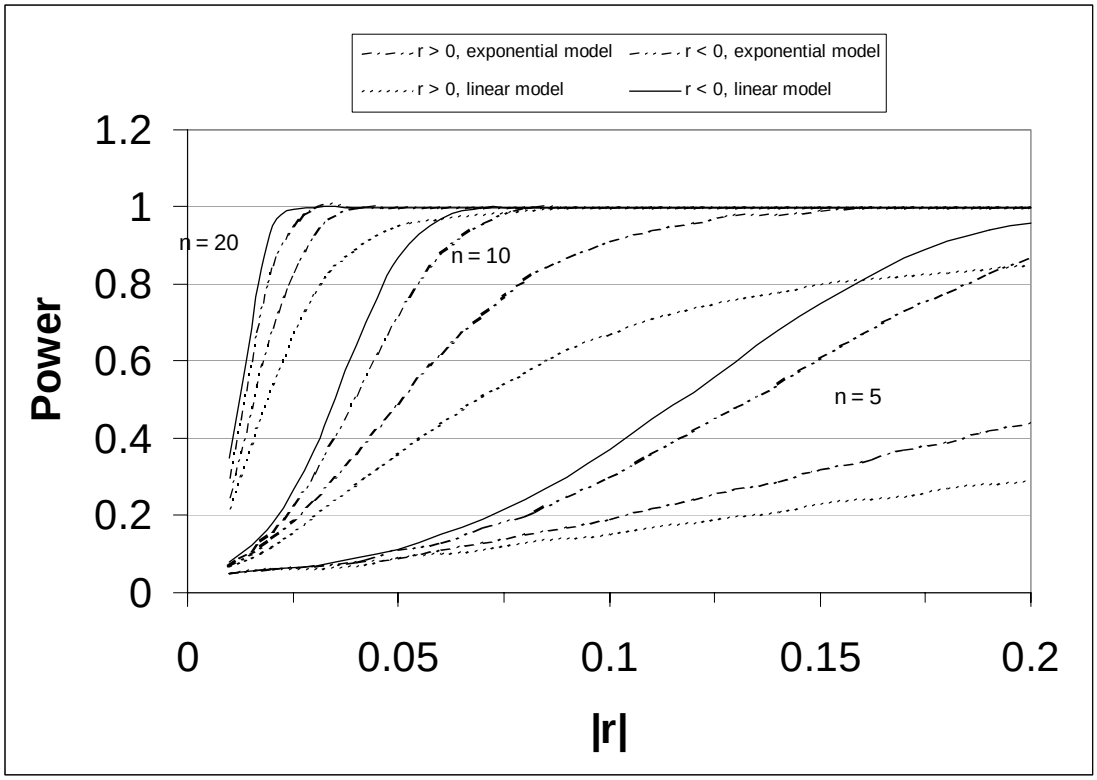


Figure 12. Power to detect a change in population density for 4 to 8 leaved plants as a function of the number of years monitored (n), rate of population change (r > 0 or < 0), and linear vs. exponential models of change.
Curves shown use a model with the assumption that CV is proportional to 1/√density, with CV = 0.18 and α = 0.05.

Table 1. The proportion of mapped plants present 2000 to 2004. Values represent means averaged across plots.

Year	Number of leaves	Plants present	Proportion of total	Number of plots represented
2000	1	3	0.07	10
	1 - 3	16	0.40	16
	>= 4	24	0.60	17
	Total	41		
2001	1	11	0.12	13
	1 – 3	52	0.55	20
	>= 4	42	0.45	20
	Total	95		
2002	1	5	0.08	10
	1 – 3	28	0.48	18
	>= 4	31	0.52	17
	Total	59		
2003	1	15	0.15	15
	1 – 3	57	0.58	19
	>= 4	41	0.42	17
	Total	98		
2004	1	12	0.15	14
	1 - 3	49	0.59	19
	>= 4	34	0.41	18
	Total	82		

Table 2. Percentage of mapped purple amole plants present and the percentage of those present that are reproductive and vegetative in relation to the percentage of long-term average precipitation for 1998 to 2004.

Year	**Percentage of average precipitation**	**Present**		**Reproductive**		**Vegetative**	
	——————————————— % ———————————————						
		Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
1998	241	100	0	56	7.1	44	7.1
1999	79	43	7.6	31	8.5	69	8.5
2000	91	34	4.7	63	6.2	37	6.2
2001	84	52	5.4	27	4.4	73	4.4
2002	52	42	5.3	13	3.3	87	3.3
2003	100	58	5.1	24	5.4	76	5.4
2004	59	61	5.5	18	4.2	82	4.2

Table 3. Proportion of flowering plants that produced seeds and the number of seeds produced per plant by year.
Values represent mean and standard error of the mean across plots.

Year	N	Proportion of flowering plants that produced seed		Number of seeds produced	
		Mean	SEM	Mean	SEM
2000	20	0.52	0.082	13.7	3.09
2001	20	0.60	0.070	11.9	2.85
2002	14	0.22	0.073	5.6	2.39
2003	17	0.66	0.077	17.0	3.47
2004	16	0.37	0.094	5.7	1.71

Table 4. Persistence of original 1-leafed plants mapped in either 1998 or 2000.
Values represent means as averaged across plots (N)

Year mapped	**N**	**Percentage living in 2004**		**Years lived**	
		Mean	**SD**	**Mean**	**SD**
1998	8	34	16.7	3.0	0.99
2000	17	91	5.8	2.6	0.18

Table 5. Percentage of plots disturbed by years.
Values represent means and SEM for various animal and human disturbance types.

Year	Total		Animal		Gopher		Multi-animal		Human		Vehicle		Multi-human		Fire		Road	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
	%																	
2000	39	5.3	36	5.5	36	5.5	0	0.0	3	1.2	2	1.2	0	0.0	0	0.0	0	0.2
2001	50	6.1	49	6.2	49	6.2	0	0.0	1	0.3	0	0.3	0	0.0	0	0.0	0	0.2
2002	68	5.9	65	5.9	63	5.8	1	0.5	15	6.2	2	0.9	0	0.4	13	6.1	0	0.0
2003	50	5.3	47	5.3	45	5.5	0	0.3	3	2.9	3	2.7	0	0.2	0	0.0	0	0.0
2004	42	4.6	39	5.0	30	4.9	0	0.3	3	1.6	2	1.3	0	0.0	0	0.0	1	0.6

Table 6. Correlations between type of disturbance and density and change in density of purple amole from one year to the next.

Disturbance Type	Density	Change in density
Total	-0.058	-0.242
Animal	-0.039	-0.218
Gopher	-0.040	-0.191
Multi-animal	0.274	-0.184
Human	0.092	-0.407***
Fire	0.141	-0.440***
Vehicle	-0.062	-0.043
Road	-0.030	-0.010
Multi-human	0.013	-0.103
*** Denotes significance at $P \leq 0.001$ level.		

Table 7. Percentage cover and SEM averaged across years and plots.

N	Total herbaceous species		Native species		Non-native species		Bare ground		Gopher disturbance		Pest disturbance		Presence of crusts	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
115	67.0	1.88	20.7	1.32	50.5	2.53	25.5	2.21	6.2	0.67	4.2	0.40	0.50	0.037

Table 8. Correlations (r) between density of purple amole and percentage cover of vegetation associates and presence of biological crusts.

Vegetation associates	Density of purple amole
Total herbaceous species	0.024
Native species	0.199*
Non-native species	-0.142
Bare ground	0.038
Gopher disturbance	-0.010
Pest disturbance	-0.117
Presence of biological crusts	0.271*
* Denotes significance at $P \leq 0.05$.	

Appendix A: Flowering of Purple Amole

Proportion of plants that were reproductive by their number of leaves.
Mean ± SE was determined by averaging data across plots and years.

	Proportion reproductive		
Leaves	**N**	**Mean**	**SE**
1	62	0.00	0.000
2	92	0.02	0.010
3	86	0.07	0.018
4	89	0.29	0.036
5	78	0.46	0.042
6	80	0.57	0.045
7	67	0.73	0.046
8	55	0.78	0.048
9	41	0.82	0.053
10	25	0.83	0.075
11	17	0.94	0.059
12	13	0.77	0.122
13	3	1	0.000
14	7	0.86	0.143
16	1	0	.
17	2	1	0.000
18	1	1	.
29	1	1	.
44	1	1	.
45	1	1	.

Proportion of plants that were reproductive by the width of their widest leaf. Mean ± SE was determined by averaging data across plots and years.

Leaf width (mm)	Proportion reproductive		
	N	Mean	SE
.	51	0.26	0.044
0.5	10	0	0
1	39	0.04	0.020
1.5	44	0.08	0.035
2	51	0.11	0.037
2.2	1	0	.
2.5	38	0.12	0.047
3	55	0.26	0.044
3.5	32	0.44	0.069
4	51	0.47	0.046
4.5	25	0.67	0.078
5	51	0.62	0.050
5.5	10	0.58	0.139
6	32	0.71	0.069
6.5	10	0.85	0.107
7	11	0.81	0.121
7.5	3	1	0
8	4	1	0
8.5	1	1	.
10	1	1	.

Appendix B: Presence of Purple Amole

Proportion of mapped plants present by plot and year.

Plot	1998	1999	2000	2001	2002	2003	2004
1	1	0.71	0.65	0.76	0.62	0.81	0.79
2	1	0.44	0.41	0.45	0.37	0.38	0.49
3	1	0.45	0.56	0.56	0.52	0.37	0.54
4	1	0.13	0.07	0.39	0.08	0.66	0.48
5	1	0.50	0.00	0.00	0.00	0.50	0.50
6	1	0.44	0.15	0.36	0.21	0.82	0.78
7	1	0.00	0.37	0.27	0.41	0.66	0.65
8	1	0.00	0.36	0.79	0.42	0.66	0.45
9	1	0.50	0.60	0.40	0.20	0.20	0.00
10	1	1.00	0.33	0.67	0.50	0.50	0.83
11	1	0.88	0.80	0.87	0.87	0.93	0.87
12	1	1.00	0.57	0.84	0.82	0.82	0.90
14	1	0.35	0.41	0.84	0.58	0.82	0.62
15	1	0.00	0.00	0.33	0.33	0.33	0.56
16	1	0.26	0.29	0.60	0.74	0.50	0.42
17	.	.	0.36	1.00	0.82	0.73	1.00
18	1	0.30	0.18	0.21	0.21	0.21	0.29
19	1	0.00	0.06	0.19	0.06	0.13	0.19
20	1	1.00	0.11	0.49	0.28	0.88	0.77
21	1	0.30	0.30	0.43	0.44	0.81	0.81
22	.	.	0.57	0.43	0.43	0.43	0.50
23	1	0.31	0.32	0.52	0.41	0.54	0.96

Proportion of mapped plants present in 1998 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.05	0.95
2	0.48	0.52
3	0.36	0.64
4	0.35	0.65
5	0.00	1.00
6	0.76	0.24
7	0.39	0.61
8	0.26	0.74
9	1.00	0.00
10	1.00	0.00
11	1.00	0.00
12	0.75	0.25
14	0.11	0.89
15	0.67	0.33
16	0.61	0.39
18	0.45	0.55
19	0.73	0.27
20	1.00	0.00
21	0.68	0.32
23	0.46	0.54

Proportion of mapped plants present in 1999 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.00	1.00
2	0.57	0.43
3	0.20	0.80
4	0.00	1.00
5	0.00	1.00
6	0.00	1.00
9	0.00	1.00
10	1.00	0.00
11	0.57	0.43
12	0.25	0.75
14	0.23	0.77
16	0.00	1.00
18	0.50	0.50
20	1.00	0.00
21	0.33	0.67
23	0.25	0.75

Proportion of mapped plants present in 2000 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.22	0.78
2	0.27	0.73
3	0.78	0.22
4	0.50	0.50
6	0.61	0.39
7	0.45	0.55
8	0.55	0.45
9	1.00	0.00
10	1.00	0.00
11	1.00	0.00
12	0.68	0.32
14	0.40	0.60
16	0.36	0.64
17	0.25	0.75
18	0.80	0.20
19	1.00	0.00
20	0.88	0.12
21	0.94	0.06
22	0.50	0.50
23	0.34	0.66

Proportion of mapped plants present in 2001 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.05	0.95
2	0.22	0.78
3	0.52	0.48
4	0.12	0.88
6	0.23	0.77
7	0.37	0.63
8	0.26	0.74
9	0.50	0.50
10	0.25	0.75
11	0.77	0.23
12	0.44	0.56
14	0.11	0.89
15	0.00	1.00
16	0.24	0.76
17	0.09	0.91
18	0.17	0.83
19	0.00	1.00
20	0.12	0.88
21	0.49	0.51
22	0.50	0.50
23	0.23	0.77

Proportion of mapped plants present in 2002 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.00	1.00
2	0.06	0.94
3	0.08	0.92
4	0.00	1.00
6	0.35	0.65
7	0.32	0.68
8	0.08	0.92
9	0.00	1.00
10	0.33	0.67
11	0.38	0.62
12	0.18	0.83
14	0.00	1.00
15	0.00	1.00
16	0.04	0.96
17	0.00	1.00
18	0.00	1.00
19	0.00	1.00
20	0.08	0.92
21	0.40	0.60
22	0.33	0.67
23	0.10	0.90

Proportion of mapped plants present in 2003 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.03	0.97
2	0.22	0.78
3	0.39	0.61
4	0.03	0.97
5	0.00	1.00
6	0.11	0.89
7	0.32	0.68
8	0.10	0.90
9	0.00	1.00
10	0.00	1.00
11	0.93	0.07
12	0.50	0.50
14	0.09	0.91
15	0.00	1.00
16	0.32	0.68
17	0.25	0.75
18	0.50	0.50
19	0.00	1.00
20	0.06	0.94
21	0.45	0.55
22	0.67	0.33
23	0.29	0.71

Proportion of mapped plants present in 2004 that were reproductive and vegetative.

Plot	Reproductive	Vegetative
1	0.00	1.00
2	0.01	0.99
3	0.04	0.96
4	0.00	1.00
5	0.00	1.00
6	0.05	0.95
7	0.12	0.88
8	0.03	0.97
10	0.00	1.00
11	0.62	0.38
12	0.50	0.50
14	0.13	0.87
15	0.40	0.60
16	0.32	0.68
17	0.00	1.00
18	0.25	0.75
19	0.33	0.67
20	0.09	0.91
21	0.37	0.63
22	0.43	0.57
23	0.14	0.86

Proportion of mapped plants present by year.
Values represent means and standard errors determined across plots.

1998		1999		2000		2001		2002		2003		2004	
Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
1.00	0.000	0.43	0.076	0.34	0.048	0.52	0.054	0.42	0.053	0.58	0.051	0.61	0.055

Appendix C: Dormancy of Purple Amole

Proportion of mapped purple amole plants that have exhibited dormancy from 1998 to 2004 and the probability that an individual plant exhibits dormancy in a given year.
Values represent means ± standard error of the means determined by averaging among individual plants (N) within each plot.

Plot	N	Proportion exhibiting dormancy from 1998 to 2004		Probability of dormancy	
		Mean	SE	Mean	SE
1	84	0.31	0.051	0.14	0.028
2	140	0.28	0.038	0.09	0.014
3	48	0.13	0.048	0.04	0.019
4	109	0.34	0.046	0.08	0.014
5	2	0.50	0.500	0.21	0.214
6	303	0.18	0.022	0.05	0.007
7	139	0.19	0.034	0.02	0.007
8	149	0.26	0.036	0.06	0.011
9	5	0.00	0.000	0.00	0.000
10	6	0.17	0.167	0.03	0.033
11	15	0.13	0.091	0.05	0.032
12	49	0.14	0.051	0.06	0.029
14	117	0.42	0.046	0.08	0.011
15	9	0.56	0.176	0.08	0.042
16	113	0.11	0.029	0.05	0.017
17	11	0.36	0.152	0.11	0.052
18	28	0.14	0.067	0.03	0.021
19	16	0.13	0.085	0.04	0.036
20	229	0.27	0.029	0.07	0.009
21	113	0.11	0.029	0.00	0.001
22	14	0.29	0.125	0.02	0.018
23	101	0.16	0.037	0.04	0.011

Total years dormant from 1998 to 2004, average period of dormancy in years, and the proportion of plants that were reproductive the year following a dormant year.
Values represent means and standard error of the means of plants (N) mapped within a plot.

Plot	N	Years dormant		Period of dormancy		Proportion reproductive after dormancy	
		Mean	SE	Mean	SE	Mean	SE
1	26	1.4	0.14	1.2	0.11	0.00	0.000
2	39	1.6	0.14	1.6	0.14	0.03	0.026
3	6	1.8	0.40	1.6	0.33	0.00	0.000
4	37	1.5	0.14	1.5	0.14	0.03	0.027
5	1	3.0	.	3.0	.	0.00	.
6	54	1.3	0.07	1.2	0.06	0.07	0.036
7	27	1.2	0.09	1.2	0.09	0.00	0.000
8	38	1.3	0.13	1.3	0.13	0.08	0.044
9	1	1.0	.	1.0	.	0.00	.
10	2	2.0	1.00	2.0	1.00	0.00	0.000
11	7	1.0	0.00	1.0	0.00	0.00	0.000
12	49	1.1	0.05	1.1	0.03	0.02	0.020
14	5	0.0	0.00	0.0	0.00	0.00	0.000
15	12	1.1	0.15	1.1	0.15	0.00	0.000
16	4	1.3	0.25	1.3	0.25	0.00	0.000
17	4	1.8	0.75	1.8	0.75	0.00	0.000
18	2	2.5	1.50	2.5	1.50	0.50	0.500
19	61	1.2	0.06	1.1	0.05	0.07	0.032
20	12	0.9	0.08	0.9	0.08	0.00	0.000
21	4	1.0	0.00	1.0	0.00	0.00	0.000
22	16	1.3	0.11	1.3	0.11	0.00	0.000
23	26	1.4	0.14	1.2	0.11	0.00	0.000

Appendix D: Seed Production for Purple Amole

Proportion of flowering plants that produced seeds and the number of seeds produced by plot and year.
N represents the number of individual plants averaged to compute each plot and year mean.

Plot	Year	Proportion that produced seeds		Number of seeds produced	
		N	Mean	N	Mean
1	2000	12	0.25	12	1.3
1	2001	4	0.00	4	0.0
1	2003	2	0.00	2	0.0
2	2000	16	0.50	16	18.3
2	2001	14	0.93	14	31.9
2	2002	3	0.00	3	0.0
2	2003	12	0.83	12	20.9
2	2004	1	1.00	1	6.0
3	2000	21	0.57	21	6.4
3	2001	26	0.73	26	8.9
3	2002	2	0.00	2	0.0
3	2003	7	1.00	7	27.3
3	2004	1	0.00	1	0.0
4	2000	4	1.00	4	18.8
4	2001	13	0.54	13	7.5
4	2003	2	0.50	2	37.5
6	2000	27	0.59	27	16.2
6	2001	25	0.44	25	7.8
6	2002	22	0.73	22	23.5
6	2003	27	0.85	27	13.9
6	2004	11	0.36	11	4.2
7	2000	23	0.13	23	0.6
7	2001	14	0.36	14	0.9
7	2002	18	0.39	18	7.7
7	2003	29	0.52	29	5.7
7	2004	11	0.09	11	0.3
8	2000	29	0.24	29	2.6
8	2001	34	0.53	34	10.1
8	2002	5	0.40	5	13.8
8	2003	10	0.60	10	11.2
8	2004	2	0.00	2	0.0

Plot	Year	Proportion that produced seeds		Number of seeds produced	
		N	Mean	N	Mean
9	2000	3	1.00	3	46.7
9	2001	7	0.00	7	0.0
10	2000	2	1.00	2	6.5
10	2001	5	0.20	5	0.2
10	2002	1	0.00	1	0.0
11	2000	12	0.67	12	36.7
11	2001	18	0.89	18	20.9
11	2002	5	0.00	5	0.0
11	2003	13	0.62	13	11.6
11	2004	8	0.13	8	3.5
12	2000	19	0.74	19	15.9
12	2001	26	0.46	26	4.0
12	2002	7	0.14	7	3.4
12	2003	20	0.65	20	18.5
12	2004	22	0.55	22	22.1
14	2000	57	0.00	57	0.0
14	2001	46	0.78	46	11.8
14	2002	1	0.00	1	0.0
14	2003	12	0.50	12	5.4
14	2004	9	0.00	9	0.0
15	2001	5	0.80	5	23.8
15	2004	2	0.50	2	8.0
16	2000	12	0.42	12	11.1
16	2001	52	0.90	52	17.6
16	2002	3	0.00	3	0.0
16	2003	18	0.72	18	11.3
16	2004	15	1.00	15	15.6
17	2000	1	0.00	1	0.0
17	2001	1	1.00	1	3.0
17	2003	2	0.00	2	0.0
18	2000	4	0.00	4	0.0
18	2001	9	0.33	9	4.3
18	2003	3	0.33	3	14.3
18	2004	2	0.50	2	1.5
19	2000	1	0.00	1	0.0
19	2004	1	0.00	1	0.0
20	2000	29	0.72	29	21.4
20	2001	19	0.89	19	16.1
20	2002	5	0.20	5	0.8
20	2003	18	0.67	18	12.2
20	2004	18	0.56	18	10.3
21	2000	31	0.77	31	35.4
21	2001	34	0.56	34	5.4

Plot	Year	Proportion that produced seeds		Number of seeds produced	
		N	Mean	N	Mean
21	2002	19	0.68	19	25.5
21	2003	40	0.67	40	15.8
21	2004	33	0.24	33	4.5
22	2000	4	1.00	4	24.0
22	2001	4	0.75	4	51.8
22	2002	2	0.00	2	0.0
22	2003	4	1.00	4	58.3
22	2004	3	0.00	3	0.0
23	2000	11	0.73	11	11.7
23	2001	12	1.00	12	11.5
23	2002	4	0.50	4	4.0
23	2003	16	0.94	16	24.3
23	2004	14	1.00	14	15.4

Proportion of flowering plants that produced seeds by leaf number and year. Values represent means across plots and plants within plots.

Leaves	Year	Proportion flowering		Proportion that produced seed	
		Mean	SEM	Mean	SEM
1	2000	0.00	0.000	0.00	0.000
1	2001	0.00	0.000	0.00	0.000
1	2002	0.00	0.000	0.00	0.000
1	2003	0.00	0.000	0.00	0.000
1	2004	0.00	0.000	0.00	0.000
2	2000	0.07	0.043	0.03	0.031
2	2001	0.01	0.010	0.01	0.010
2	2002	0.00	0.003	0.00	0.003
2	2003	0.04	0.027	0.01	0.009
2	2004	0.00	0.000	0.00	0.000
3	2000	0.25	0.082	0.10	0.051
3	2001	0.05	0.017	0.03	0.014
3	2002	0.01	0.015	0.00	0.000
3	2003	0.07	0.028	0.02	0.011
3	2004	0.01	0.004	0.00	0.004
4	2000	0.72	0.067	0.33	0.090
4	2001	0.21	0.048	0.10	0.030
4	2002	0.06	0.033	0.03	0.018
4	2003	0.24	0.071	0.12	0.041
4	2004	0.27	0.079	0.17	0.069
5	2000	0.74	0.067	0.41	0.087
5	2001	0.56	0.080	0.43	0.071
5	2002	0.24	0.080	0.06	0.037
5	2003	0.40	0.088	0.33	0.078
5	2004	0.40	0.103	0.24	0.094

Leaves	Year	Proportion flowering		Proportion that produced seed	
		Mean	SEM	Mean	SEM
6	2000	0.97	0.024	0.48	0.099
6	2001	0.67	0.073	0.39	0.079
6	2002	0.13	0.070	0.08	0.046
6	2003	0.60	0.090	0.47	0.083
6	2004	0.53	0.104	0.16	0.088
7	2000	0.93	0.067	0.52	0.104
7	2001	0.82	0.080	0.60	0.099
7	2002	0.33	0.105	0.09	0.051
7	2003	0.78	0.085	0.67	0.082
7	2004	0.74	0.118	0.12	0.054
8	2000	0.97	0.030	0.68	0.117
8	2001	0.76	0.081	0.45	0.110
8	2002	0.57	0.128	0.18	0.090
8	2003	0.91	0.091	0.77	0.124
8	2004	0.75	0.164	0.25	0.137
9	2000	1.00	0.000	0.73	0.129
9	2001	0.97	0.019	0.74	0.110
9	2002	0.52	0.165	0.21	0.140
9	2003	0.60	0.212	0.42	0.141
9	2004	0.70	0.200	0.34	0.189
10	2000	1.00	0.000	1.00	0.000
10	2001	1.00	0.000	0.57	0.202
10	2002	0.50	0.224	0.17	0.167
10	2003	0.75	0.250	0.75	0.250
10	2004	0.83	0.167	0.00	0.000
11	2000	1.00	0.000	0.33	0.333
11	2001	1.00	0.000	0.71	0.184
11	2002	1.00	.	0.00	.
11	2003	0.75	0.250	0.50	0.289
11	2004	1.00	0.000	0.00	0.000
12	2001	1.00	.	1.00	.
12	2002	0.60	0.245	0.20	0.200
12	2003	0.80	0.200	0.73	0.194
12	2004	1.00	0.000	0.50	0.500
13	2001	1.00	0.000	0.50	0.500
13	2003	1.00	.	0.50	.
14	2000	1.00	.	1.00	.
14	2001	1.00	0.000	0.50	0.500
14	2002	0.50	0.500	0.00	0.000
14	2003	1.00	.	1.00	.
14	2004	1.00	.	0.00	.
16	2002	0.00	.	0.00	.
17	2003	1.00	.	1.00	.

Leaves	Year	Proportion flowering		Proportion that produced seed	
		Mean	SEM	Mean	SEM
17	2004	1.00	.	0.00	.
18	2001	1.00	.	0.00	.
29	2004	1.00	.	0.00	.
44	2004	1.00	.	0.00	.
45	2003	1.00	.	1.00	.

Mean proportion of flowering plants that produced seeds and the number of seeds produced per individual flowering plant by plot and their number of leaves.
Values represent means of individual plants within plots and across years.

Plot	Leaves	N	Proportion of flowering plants producing seed	Number of seeds produced
1	4	6	0.00	0
1	5	4	0.25	2
1	6	7	0.29	1
1	10	1	0.00	0
2	.	1	1.00	24
2	0	4	0.50	5
2	3	1	1.00	8
2	4	3	0.67	3
2	5	15	0.80	13
2	6	9	0.56	18
2	7	4	0.25	26
2	8	5	0.80	35
2	9	2	1.00	55
2	11	2	1.00	94
3	.	1	0.00	0
3	2	2	1.00	10
3	3	2	0.00	0
3	4	6	0.67	8
3	5	18	0.67	5
3	6	7	0.57	8
3	7	15	0.87	19
3	8	3	0.33	1
3	9	2	0.50	29
3	10	1	1.00	5
4	0	1	1.00	75
4	3	1	1.00	7
4	4	4	0.50	6
4	5	2	1.00	4
4	6	4	0.75	7
4	7	1	1.00	20
4	8	1	0.00	0
4	9	4	0.25	12

Plot	Leaves	N	Proportion of flowering plants producing seed	Number of seeds produced
4	10	1	1.00	36
6	.	3	0.00	0
6	3	2	0.50	11
6	4	12	0.58	5
6	5	17	0.76	16
6	6	20	0.70	10
6	7	21	0.57	12
6	8	13	0.62	23
6	9	11	0.82	24
6	10	6	0.33	13
6	11	3	0.00	0
6	12	4	1.00	30
7	2	2	0.50	6
7	3	9	0.00	0
7	4	27	0.37	3
7	5	20	0.40	3
7	6	17	0.35	2
7	7	7	0.29	3
7	8	4	0.75	17
7	9	3	0.00	0
7	11	2	0.00	0
7	13	1	0.00	0
7	14	3	0.33	12
8	.	3	1.00	9
8	3	6	0.00	0
8	4	15	0.27	4
8	5	17	0.24	3
8	6	17	0.59	12
8	7	14	0.57	12
8	8	7	0.43	6
8	9	1	1.00	60
9	6	4	0.25	5
9	7	3	0.00	0
9	8	2	0.50	25
9	9	1	1.00	73
10	4	3	0.67	3
10	5	1	0.00	0
10	6	3	0.00	0
10	7	1	1.00	4
11	.	1	0.00	0
11	5	4	0.50	5
11	6	5	0.60	15
11	7	11	0.64	13

Plot	Leaves	N	Proportion of flowering plants producing seed	Number of seeds produced
11	8	15	0.67	29
11	9	11	0.36	9
11	10	5	1.00	40
11	11	1	1.00	9
11	12	2	0.50	4
11	14	1	0.00	0
12	.	1	1.00	1
12	2	1	1.00	4
12	3	3	1.00	6
12	4	7	0.57	5
12	5	12	0.67	8
12	6	23	0.52	13
12	7	30	0.37	12
12	8	8	0.63	14
12	9	4	1.00	39
12	10	2	1.00	59
12	11	2	0.00	0
12	12	1	1.00	104
14	.	46	0.00	0
14	2	3	0.33	5
14	3	4	0.75	5
14	4	16	0.50	3
14	5	17	0.47	5
14	6	18	0.56	7
14	7	10	0.50	9
14	8	5	0.40	15
14	9	4	0.75	13
14	10	1	1.00	41
14	11	1	1.00	50
15	4	1	0.00	0
15	6	2	0.50	8
15	7	1	1.00	33
15	8	1	1.00	42
15	9	1	1.00	15
15	11	1	1.00	29
16	0	1	1.00	19
16	2	2	0.50	10
16	3	9	0.56	6
16	4	27	0.70	8
16	5	22	0.91	12
16	6	22	0.95	19
16	7	6	0.67	21
16	8	5	0.80	31

Plot	Leaves	N	Proportion of flowering plants producing seed	Number of seeds produced
16	9	4	0.75	28
16	10	1	1.00	22
16	11	1	1.00	101
17	3	1	0.00	0
17	5	2	0.50	2
17	8	1	0.00	0
18	2	1	0.00	0
18	3	1	0.00	0
18	4	7	0.14	0
18	5	3	0.67	7
18	6	1	0.00	0
18	7	3	0.33	6
18	8	1	1.00	43
18	10	1	0.00	0
19	4	2	0.00	0
20	.	4	0.50	7
20	0	3	0.33	3
20	2	3	0.67	9
20	4	8	0.38	6
20	5	14	0.57	12
20	6	10	0.60	14
20	7	20	0.75	17
20	8	14	0.93	17
20	9	9	0.89	35
20	10	2	1.00	17
20	11	1	1.00	10
20	12	1	0.00	0
21	.	1	1.00	20
21	2	1	1.00	12
21	3	3	0.67	8
21	4	12	0.83	11
21	5	19	0.63	15
21	6	19	0.58	9
21	7	20	0.60	23
21	8	30	0.60	12
21	9	20	0.55	20
21	10	7	0.57	19
21	11	9	0.11	3
21	12	5	0.40	19
21	13	3	0.67	9
21	14	2	1.00	196
21	17	2	0.50	11
21	18	1	0.00	0

Plot	Leaves	N	Proportion of flowering plants producing seed	Number of seeds produced
21	29	1	0.00	0
21	44	1	0.00	0
21	45	1	1.00	6
22	3	2	1.00	16
22	4	1	1.00	17
22	5	1	1.00	22
22	6	2	0.50	23
22	7	4	0.50	27
22	8	1	1.00	9
22	9	1	0.00	0
22	10	3	0.67	54
22	12	2	0.50	71
23	3	5	1.00	11
23	4	13	0.92	13
23	5	18	0.94	13
23	6	9	0.78	18
23	7	9	0.89	26
23	8	1	0.00	0
23	9	2	1.00	14

Proportion of flowering plants that produced seeds and the number of seeds produced per individual flowering plant by their number of leaves.
Values represent means across years, plots, and plants within plots.

		Proportion of flowering plants that produced seed		Number of seeds produced	
Leaves	N	Mean	SE	Mean	SE
.	9	0.50	0.167	7	3.1
0	4	0.71	0.172	25	16.9
2	8	0.63	0.129	7	1.4
3	14	0.53	0.119	6	1.3
4	18	0.49	0.073	5	1.1
5	18	0.61	0.065	8	1.4
6	19	0.51	0.056	10	1.5
7	18	0.60	0.067	16	2.2
8	18	0.58	0.079	18	3.3
9	16	0.68	0.090	27	5.3
10	12	0.71	0.115	25	5.8
11	10	0.61	0.159	30	12.4
12	6	0.57	0.156	38	16.8
13	2	0.33	0.333	5	4.5

		Proportion of flowering plants that produced seed		Number of seeds produced	
Leaves	**N**	**Mean**	**SE**	**Mean**	**SE**
14	3	0.44	0.294	69	63.4
17	1	0.50	.	11	.
18	1	0.00	.	0	.
29	1	0.00	.	0	.
44	1	0.00	.	0	.
45	1	1.00	.	6	.

Appendix E: Persistence of Purple Amole

Proportion of plants presumed still living in 2004 and average years lived.
Values represent mean and standard deviation by plot and year the plants were mapped.

			Proportion still living		Years lived	
Plot	Mapped	N	Mean	SD	Mean	SD
1	1998	20	0.85	0.366	6.2	1.60
1	2000	64	0.92	0.270	3.8	1.40
2	1998	31	0.39	0.495	3.8	2.30
2	2000	109	0.85	0.356	2.7	1.55
3	1998	11	0.45	0.522	3.4	2.50
3	2000	37	0.86	0.347	3.0	1.64
4	1998	23	0.43	0.507	3.5	2.62
4	2000	86	0.77	0.425	2.1	1.23
5	1998	2	0.50	0.707	4	4.24
6	1998	41	0.46	0.505	3.8	2.82
6	2000	262	0.97	0.172	2.5	1.29
7	1998	33	0.42	0.502	4.1	2.51
7	2000	106	0.91	0.294	2.5	1.31
8	1998	38	0.92	0.273	6.4	1.43
8	2000	111	0.68	0.467	2.5	1.26
9	1998	3	0.00	0.000	2.0	1.73
9	2000	2	0.50	0.707	3.0	2.83
10	1998	1	1.00	.	7.0	.
10	2000	5	0.80	0.447	2.6	1.82
11	1998	8	1.00	0.000	7.0	0.00
11	2000	7	1.00	0.000	4.0	1.41
12	1998	4	0.75	0.500	5.3	2.36
12	2000	45	1.00	0.000	4.1	1.27
14	1998	37	0.92	0.277	6.4	1.67
14	2000	80	0.89	0.318	3.1	1.26
15	1998	6	0.33	0.516	3.0	3.10
15	2000	3	1.00	0.000	4.0	0.00
16	1998	23	0.26	0.449	2.6	2.42
16	2000	90	0.94	0.230	3.0	1.34
17	2000	11	1.00	0.000	4.4	0.50
18	1998	20	0.20	0.410	2.5	2.28
18	2000	8	0.63	0.518	2.1	1.55
19	1998	11	0.09	0.302	1.5	1.81
19	2000	5	0.40	0.548	1.8	1.30

Plot	Mapped	N	Proportion still living		Years lived	
			Mean	SD	Mean	SD
20	1998	1	1.00	.	7.0	.
20	2000	228	0.95	0.215	2.8	1.22
21	1998	19	0.32	0.478	2.9	2.87
21	2000	94	0.98	0.145	3.0	1.51
22	2000	14	0.50	0.519	2.4	1.60
23	1998	13	1.00	0.000	7.0	0.00
23	2000	88	0.99	0.107	2.6	1.73

Proportion of plants still living in 2004 and average years lived.
Values represent mean and standard deviation of plants by plot, year the plants were mapped, and their average number of leaves across years.

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
1	1998	2	7	0.86	0.378	6.3	1.50
1	1998	3	3	0.67	0.577	5.7	2.31
1	1998	4	4	1.00	0.000	6.8	0.50
1	1998	5	4	0.75	0.500	5.3	2.36
1	1998	7	2	1.00	0.000	7.0	0.00
1	2000	1	2	1.00	0.000	2.0	0.00
1	2000	2	26	0.96	0.196	3.4	1.47
1	2000	3	21	0.95	0.218	4.3	1.06
1	2000	4	9	0.89	0.333	4.1	1.27
1	2000	5	4	1.00	0.000	5.0	0.00
1	2000	6	2	0.00	0.000	1.5	0.71
2	1998	2	13	0.46	0.519	3.9	2.36
2	1998	3	2	0.00	0.000	2.5	2.12
2	1998	4	3	0.67	0.577	5.7	1.53
2	1998	5	6	0.33	0.516	3.8	2.48
2	1998	6	1	0.00	.	2.0	.
2	1998	7	2	0.50	0.707	3.5	3.54
2	1998	8	1	0.00	.	3.0	.
2	1998	9	1	1.00	.	7.0	.
2	1998	10	1	0.00	.	2.0	.
2	1998	12	1	0.00	.	1.0	.
2	2000	0	4	1.00	0.000	1.8	1.50
2	2000	1	25	0.84	0.374	3.2	1.76
2	2000	2	60	0.87	0.343	2.4	1.40
2	2000	3	12	0.83	0.389	3.2	1.64
2	2000	4	3	0.67	0.577	3.3	1.15

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
2	2000	5	4	1.00	0.000	2.8	1.26
2	2000	6	1	0.00	.	1.0	.
3	1998	2	4	0.50	0.577	4.0	2.58
3	1998	3	2	0.00	0.000	1.0	0.00
3	1998	4	3	0.67	0.577	3.7	2.31
3	1998	6	1	0.00	.	1.0	.
3	1998	7	1	1.00	.	7.0	.
3	2000	1	2	1.00	0.000	3.5	2.12
3	2000	2	12	1.00	0.000	2.8	1.86
3	2000	3	8	0.88	0.354	2.9	1.55
3	2000	4	5	1.00	0.000	4.4	1.34
3	2000	5	6	0.67	0.516	2.8	1.33
3	2000	6	2	0.50	0.707	3.5	2.12
3	2000	7	2	0.50	0.707	1.5	0.71
4	1998	2	10	0.60	0.516	4.2	2.78
4	1998	3	6	0.17	0.408	2.3	2.16
4	1998	4	4	0.25	0.500	2.3	2.50
4	1998	5	2	1.00	0.000	6.5	0.71
4	1998	6	1	0.00	.	2.0	.
4	2000	0	1	1.00	.	1.0	.
4	2000	1	17	0.94	0.243	2.5	1.37
4	2000	2	42	0.76	0.431	2.2	1.25
4	2000	3	10	0.80	0.422	2.1	1.37
4	2000	4	9	0.56	0.527	1.9	0.93
4	2000	5	1	1.00	.	1.0	.
4	2000	6	5	0.60	0.548	1.4	0.55
4	2000	9	1	0.00	.	2.0	.
5	1998	3	1	1.00	.	7.0	.
5	1998	4	1	0.00	.	1.0	.
6	1998	0	2	0.50	0.707	3.0	2.83
6	1998	1	1	0.00	.	1.0	.
6	1998	2	6	0.67	0.516	5.0	3.10
6	1998	3	4	0.25	0.500	3.3	2.63
6	1998	4	9	0.56	0.527	4.3	2.96
6	1998	5	8	0.63	0.518	4.5	2.98
6	1998	6	1	1.00	.	7.0	.
6	1998	7	3	0.67	0.577	5.3	2.89
6	1998	8	2	0.00	0.000	1.5	0.71
6	1998	9	2	0.00	0.000	1.0	0.00
6	1998	10	1	0.00	.	1.0	.
6	1998	11	1	0.00	.	1.0	.
6	1998	12	1	0.00	.	1.0	.
6	2000	1	94	1.00	0.000	2.3	1.05

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
6	2000	2	131	0.95	0.226	2.4	1.27
6	2000	3	16	1.00	0.000	3.1	1.12
6	2000	4	15	1.00	0.000	4.5	0.83
6	2000	5	3	0.67	0.577	2.3	2.31
6	2000	6	1	1.00	.	2.0	.
6	2000	7	1	1.00	.	5.0	.
6	2000	8	1	1.00	.	5.0	.
7	1998	1	1	0.00	.	1.0	.
7	1998	2	14	0.50	0.519	4.1	2.93
7	1998	3	5	0.60	0.548	5.0	2.55
7	1998	4	6	0.50	0.548	4.3	2.34
7	1998	5	3	0.00	0.000	2.3	1.15
7	1998	6	2	0.00	0.000	3.5	0.71
7	1998	7	1	0.00	.	3.0	.
7	1998	11	1	1.00	.	7.0	.
7	2000	1	27	0.89	0.320	2.4	1.28
7	2000	2	45	0.96	0.208	2.2	1.28
7	2000	3	15	0.87	0.352	2.9	1.36
7	2000	4	9	1.00	0.000	3.2	1.48
7	2000	5	4	0.75	0.500	2.5	1.00
7	2000	6	3	0.67	0.577	2.7	0.58
7	2000	7	1	1.00	.	5.0	.
7	2000	8	1	1.00	.	3.0	.
7	2000	13	1	0.00	.	1.0	.
8	1998	1	10	0.80	0.422	5.6	2.46
8	1998	2	12	0.92	0.289	6.3	0.89
8	1998	3	4	1.00	0.000	7.0	0.00
8	1998	4	2	1.00	0.000	7.0	0.00
8	1998	5	3	1.00	0.000	7.0	0.00
8	1998	6	4	1.00	0.000	7.0	0.00
8	1998	7	3	1.00	0.000	7.0	0.00
8	2000	1	37	0.89	0.315	2.4	1.24
8	2000	2	45	0.71	0.458	2.5	1.25
8	2000	3	14	0.36	0.497	2.1	0.92
8	2000	4	7	0.57	0.535	3.3	1.60
8	2000	5	4	0.25	0.500	2.5	1.73
8	2000	6	4	0.25	0.500	2.5	1.73
9	1998	5	1	0.00	.	4.0	.
9	1998	6	1	0.00	.	1.0	.
9	1998	10	1	0.00	.	1.0	.
9	2000	5	1	1.00	.	5.0	.
9	2000	6	1	0.00	.	1.0	.
10	1998	4	1	1.00	.	7.0	.

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
10	2000	1	3	1.00	0.000	2.7	2.08
10	2000	2	2	0.50	0.707	2.5	2.12
11	1998	4	2	1.00	0.000	7.0	0.00
11	1998	5	1	1.00	.	7.0	.
11	1998	6	2	1.00	0.000	7.0	0.00
11	1998	8	1	1.00	.	7.0	.
11	1998	9	1	1.00	.	7.0	.
11	1998	10	1	1.00	.	7.0	.
11	2000	1	2	1.00	0.000	2.5	2.12
11	2000	3	2	1.00	0.000	5.0	0.00
11	2000	5	1	1.00	.	4.0	.
11	2000	7	1	1.00	.	4.0	.
11	2000	8	1	1.00	.	5.0	.
12	1998	4	1	1.00	.	5.0	.
12	1998	5	1	0.00	.	2.0	.
12	1998	6	1	1.00	.	7.0	.
12	1998	8	1	1.00	.	7.0	.
12	2000	1	3	1.00	0.000	3.3	2.08
12	2000	2	12	1.00	0.000	3.7	1.30
12	2000	3	11	1.00	0.000	3.8	1.25
12	2000	4	7	1.00	0.000	4.9	0.38
12	2000	5	7	1.00	0.000	4.3	1.50
12	2000	6	3	1.00	0.000	4.3	1.15
12	2000	7	2	1.00	0.000	5.0	0.00
14	1998	0	2	0.50	0.707	3.5	3.54
14	1998	1	12	0.92	0.289	6.5	1.73
14	1998	2	14	0.93	0.267	6.5	1.61
14	1998	3	6	1.00	0.000	7.0	0.00
14	1998	5	3	1.00	0.000	6.3	1.15
14	2000	0	2	0.00	0.000	0.0	0.00
14	2000	1	10	1.00	0.000	3.6	1.26
14	2000	2	37	0.89	0.315	3.1	1.25
14	2000	3	18	0.89	0.323	3.0	1.19
14	2000	4	7	0.86	0.378	3.0	1.00
14	2000	5	5	1.00	0.000	3.6	0.55
14	2000	7	1	1.00	.	3.0	.
15	1998	2	2	0.50	0.707	4.0	4.24
15	1998	7	2	0.50	0.707	4.0	4.24
15	1998	8	1	0.00	.	1.0	.
15	1998	9	1	0.00	.	1.0	.
15	2000	2	2	1.00	0.000	4.0	0.00
15	2000	3	1	1.00	.	4.0	.
16	1998	1	2	0.00	0.000	1.0	0.00

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
16	1998	2	7	0.29	0.488	2.1	1.95
16	1998	3	3	0.33	0.577	3.3	3.21
16	1998	4	8	0.13	0.354	2.1	2.23
16	1998	5	2	0.50	0.707	4.0	4.24
16	1998	6	1	1.00	.	7.0	.
16	2000	0	1	1.00	.	2.0	.
16	2000	1	23	0.96	0.209	2.4	1.31
16	2000	2	41	0.95	0.218	3.0	1.35
16	2000	3	17	1.00	0.000	3.6	0.94
16	2000	4	6	1.00	0.000	4.5	0.84
16	2000	5	1	0.00	.	2.0	.
16	2000	6	1	0.00	.	1.0	.
17	2000	1	2	1.00	0.000	4.0	0.00
17	2000	2	7	1.00	0.000	4.4	0.53
17	2000	3	2	1.00	0.000	4.5	0.71
18	1998	1	2	0.00	0.000	1.0	0.00
18	1998	2	4	0.25	0.500	3.0	2.83
18	1998	3	6	0.17	0.408	2.2	1.94
18	1998	4	4	0.25	0.500	2.8	2.87
18	1998	5	2	0.00	0.000	1.0	0.00
18	1998	6	1	0.00	.	2.0	.
18	1998	7	1	1.00	.	7.0	.
18	2000	2	4	0.75	0.500	3.3	1.50
18	2000	3	1	1.00	.	1.0	.
18	2000	4	3	0.33	0.577	1.0	0.00
19	1998	3	3	0.00	0.000	1.0	0.00
19	1998	5	2	0.00	0.000	1.0	0.00
19	1998	6	2	0.00	0.000	1.0	0.00
19	1998	7	1	1.00	.	7.0	.
19	1998	8	1	0.00	.	1.0	.
19	1998	12	1	0.00	.	1.0	.
19	1998	13	1	0.00	.	1.0	.
19	2000	2	3	0.67	0.577	2.3	1.53
19	2000	4	2	0.00	0.000	1.0	0.00
20	1998	8	1	1.00	.	7.0	.
20	2000	1	94	0.98	0.145	2.8	1.12
20	2000	2	107	0.98	0.136	2.6	1.12
20	2000	3	7	0.86	0.378	3.4	1.40
20	2000	4	5	0.80	0.447	4.0	1.73
20	2000	5	10	0.80	0.422	3.8	1.62
20	2000	6	1	1.00	.	5.0	.
20	2000	7	1	1.00	.	5.0	.
20	2000	8	1	0.00	.	1.0	.

Plot	Mapped	Leaves	N	Proportion still living		Years lived	
				Mean	SD	Mean	SD
20	2000	9	1	0.00	.	1.0	.
20	2000	10	1	0.00	.	1.0	.
21	1998	1	1	0.00	.	1.0	.
21	1998	2	5	0.60	0.548	4.6	3.29
21	1998	3	4	0.50	0.577	4.0	3.46
21	1998	4	3	0.00	0.000	1.0	0.00
21	1998	5	3	0.00	0.000	1.0	0.00
21	1998	6	2	0.00	0.000	1.0	0.00
21	1998	11	1	1.00	.	7.0	.
21	2000	1	16	1.00	0.000	2.0	0.63
21	2000	2	35	1.00	0.000	2.2	1.09
21	2000	3	10	0.90	0.316	2.8	1.81
21	2000	4	9	0.89	0.333	4.2	0.97
21	2000	5	7	1.00	0.000	4.6	1.13
21	2000	6	10	1.00	0.000	4.5	0.97
21	2000	7	4	1.00	0.000	4.0	1.41
21	2000	8	1	1.00	.	5.0	.
21	2000	9	1	1.00	.	5.0	.
21	2000	11	1	1.00	.	5.0	.
22	2000	1	1	0.00	.	1.0	.
22	2000	2	3	0.67	0.577	2.3	1.53
22	2000	3	4	0.50	0.577	2.8	2.06
22	2000	4	3	0.33	0.577	2.0	1.73
22	2000	6	2	1.00	0.000	4.0	0.00
22	2000	7	1	0.00	.	1.0	.
23	1998	0	3	1.00	0.000	7.0	0.00
23	1998	1	3	1.00	0.000	7.0	0.00
23	1998	2	2	1.00	0.000	7.0	0.00
23	1998	3	3	1.00	0.000	7.0	0.00
23	1998	4	2	1.00	0.000	7.0	0.00
23	2000	1	28	0.96	0.189	2.3	1.47
23	2000	2	42	1.00	0.000	2.3	1.69
23	2000	3	12	1.00	0.000	3.4	1.83
23	2000	4	4	1.00	0.000	5.0	0.00
23	2000	5	2	1.00	0.000	5.0	0.00

Proportion of plants still living in 2004 and average years lived.
Values represent minimum, maximum, mean and standard error of the mean by the year the plants were mapped as averaged across plots.

Mapped	N	Proportion still alive in 2004				Years lived			
		Min	Max	Mean	SE	Min	Max	Mean	SE
1998	20	0.00	1.00	0.57	0.074	1.5	7.0	4.5	0.42
2000	21	0.40	1.00	0.84	0.041	1.8	4.4	3.0	0.15

Proportion of plants still living in 2004 and average years lived.
Values represent mean and standard deviation by the year the plants were mapped and their average number of leaves across years.

Mapped	Leaves	N	Proportion still alive		Years lived	
			Mean	SD	Mean	SD
1998	0	3	0.67	0.167	4.50	1.258
1998	1	8	0.34	0.167	3.01	0.991
1998	2	13	0.62	0.067	4.70	0.403
1998	3	14	0.48	0.107	4.16	0.606
1998	4	15	0.60	0.102	4.46	0.580
1998	5	14	0.44	0.119	3.98	0.599
1998	6	13	0.38	0.140	3.73	0.769
1998	7	9	0.74	0.118	5.65	0.572
1998	8	7	0.43	0.202	3.93	1.115
1998	9	4	0.50	0.289	4.00	1.732
1998	10	4	0.25	0.250	2.75	1.436
1998	11	3	0.67	0.333	5.00	2.000
1998	12	3	0.00	0.000	1.00	0.000
1998	13	1	0.00	.	1.00	.
2000	0	4	0.75	0.250	1.19	0.449
2000	1	17	0.91	0.058	2.65	0.175
2000	2	19	0.87	0.035	2.82	0.151
2000	3	18	0.88	0.042	3.21	0.225
2000	4	16	0.74	0.077	3.40	0.327
2000	5	15	0.81	0.080	3.41	0.321
2000	6	13	0.54	0.122	2.65	0.407
2000	7	9	0.83	0.118	3.72	0.521
2000	8	5	0.80	0.200	3.80	0.800
2000	9	3	0.33	0.333	2.67	1.202
2000	10	1	0.00	.	1.00	.
2000	11	1	1.00	.	5.00	.
2000	13	1	0.00	.	1.00	.

Proportion of plants presumed dead.
Values represent means and standard deviations by plot and average number of leaves.

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
1	-1	42	0.00	0.000
1	1	3	0.00	0.000
1	2	80	0.03	0.157
1	3	86	0.01	0.108
1	4	86	0.02	0.152
1	5	52	0.00	0.000
1	6	26	0.12	0.326
1	7	5	0.00	0.000
1	10	1	0.00	.
2	-1	66	0.00	0.000
2	0	4	0.00	0.000
2	1	35	0.06	0.236
2	2	126	0.11	0.316
2	3	59	0.03	0.183
2	4	39	0.03	0.160
2	5	36	0.22	0.422
2	6	14	0.14	0.363
2	7	9	0.11	0.333
2	8	8	0.25	0.463
2	9	5	0.20	0.447
2	10	1	0.00	.
2	11	2	0.00	0.000
2	12	1	1.00	.
3	-1	11	0.00	0.000
3	1	2	0.00	0.000
3	2	20	0.05	0.224
3	3	18	0.11	0.323
3	4	26	0.08	0.272
3	5	24	0.13	0.338
3	6	18	0.06	0.236
3	7	20	0.10	0.308
3	8	6	0.00	0.000
3	9	1	0.00	.
3	10	3	0.00	0.000
4	-1	53	0.00	0.000
4	0	1	0.00	.
4	1	22	0.00	0.000
4	2	95	0.14	0.346
4	3	34	0.24	0.431
4	4	27	0.26	0.447
4	5	13	0.00	0.000
4	6	10	0.30	0.483

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
4	7	2	0.00	0.000
4	8	4	0.25	0.500
4	9	2	0.50	0.707
5	-1	3	0.00	0.000
5	2	1	0.00	.
5	3	3	0.00	0.000
5	4	1	1.00	.
6	-1	65	0.00	0.000
6	0	2	0.50	0.707
6	1	118	0.01	0.092
6	2	280	0.04	0.186
6	3	100	0.01	0.100
6	4	80	0.04	0.191
6	5	56	0.11	0.312
6	6	41	0.02	0.156
6	7	32	0.03	0.177
6	8	15	0.07	0.258
6	9	15	0.13	0.352
6	10	8	0.13	0.354
6	11	4	0.25	0.500
6	12	5	0.20	0.447
7	-1	30	0.00	0.000
7	1	34	0.15	0.359
7	2	128	0.05	0.228
7	3	60	0.08	0.279
7	4	60	0.03	0.181
7	5	34	0.09	0.288
7	6	20	0.10	0.308
7	7	9	0.11	0.333
7	8	5	0.00	0.000
7	9	4	0.25	0.500
7	11	3	0.67	0.577
7	13	1	1.00	.
7	14	3	0.00	0.000
8	-1	82	0.00	0.000
8	1	70	0.07	0.259
8	2	165	0.08	0.270
8	3	58	0.16	0.365
8	4	39	0.13	0.339
8	5	43	0.02	0.152
8	6	25	0.08	0.277
8	7	25	0.12	0.332
8	8	7	0.00	0.000

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
9	4	1	0.00	.
9	5	2	0.00	0.000
9	6	4	0.50	0.577
9	7	2	0.50	0.707
9	8	1	0.00	.
9	9	1	0.00	.
9	10	1	1.00	.
10	-1	1	0.00	.
10	1	3	0.00	0.000
10	2	6	0.17	0.408
10	3	2	0.00	0.000
10	4	3	0.00	0.000
10	5	3	0.00	0.000
10	6	1	0.00	.
10	7	1	0.00	.
11	-1	5	0.00	0.000
11	1	4	0.00	0.000
11	2	1	0.00	.
11	3	4	0.00	0.000
11	4	2	0.00	0.000
11	5	5	0.00	0.000
11	6	10	0.00	0.000
11	7	12	0.00	0.000
11	8	17	0.00	0.000
11	9	13	0.00	0.000
11	10	7	0.00	0.000
11	11	1	0.00	.
11	12	2	0.00	0.000
11	14	1	0.00	.
12	-1	6	0.00	0.000
12	1	4	0.00	0.000
12	2	22	0.00	0.000
12	3	26	0.00	0.000
12	4	38	0.03	0.162
12	5	27	0.00	0.000
12	6	28	0.00	0.000
12	7	32	0.00	0.000
12	8	12	0.00	0.000
12	9	6	0.00	0.000
12	10	2	0.00	0.000
12	11	2	0.00	0.000
12	12	1	0.00	.
14	-1	62	0.00	0.000

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
14	0	4	0.75	0.500
14	1	29	0.03	0.186
14	2	154	0.03	0.178
14	3	93	0.02	0.146
14	4	61	0.02	0.128
14	5	43	0.00	0.000
14	6	25	0.00	0.000
14	7	7	0.00	0.000
14	8	3	0.00	0.000
14	9	5	0.00	0.000
14	11	1	0.00	.
14	12	1	0.00	.
15	-1	8	0.00	0.000
15	2	5	0.20	0.447
15	3	3	0.00	0.000
15	4	6	0.00	0.000
15	5	1	0.00	.
15	6	1	0.00	.
15	7	2	0.50	0.707
15	8	1	1.00	.
15	9	1	1.00	.
16	-1	15	0.00	0.000
16	0	1	0.00	.
16	1	31	0.10	0.301
16	2	104	0.09	0.283
16	3	66	0.02	0.123
16	4	63	0.10	0.296
16	5	24	0.04	0.204
16	6	18	0.11	0.323
16	7	5	0.00	0.000
16	8	2	0.00	0.000
16	9	2	0.00	0.000
16	10	1	0.00	.
17	-1	5	0.00	0.000
17	1	4	0.00	0.000
17	2	16	0.00	0.000
17	3	14	0.00	0.000
17	4	3	0.00	0.000
17	5	3	0.00	0.000
17	6	2	0.00	0.000
17	8	1	0.00	.
18	-1	8	0.00	0.000
18	1	2	1.00	0.000

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
18	2	14	0.21	0.426
18	3	17	0.29	0.470
18	4	13	0.46	0.519
18	5	3	0.67	0.577
18	6	4	0.25	0.500
18	7	3	0.00	0.000
18	8	1	0.00	.
19	-1	5	0.00	0.000
19	2	6	0.17	0.408
19	3	4	0.75	0.500
19	4	3	0.67	0.577
19	5	2	1.00	0.000
19	6	2	1.00	0.000
19	7	1	0.00	.
19	8	1	1.00	.
19	12	1	1.00	.
19	13	1	1.00	.
20	-1	66	0.00	0.000
20	1	136	0.01	0.121
20	2	303	0.01	0.081
20	3	41	0.02	0.156
20	4	23	0.04	0.209
20	5	21	0.10	0.301
20	6	11	0.00	0.000
20	7	21	0.00	0.000
20	8	15	0.07	0.258
20	9	3	0.33	0.577
20	10	2	0.50	0.707
20	11	1	0.00	.
20	12	1	0.00	.
21	-1	3	0.00	0.000
21	1	17	0.06	0.243
21	2	70	0.03	0.168
21	3	32	0.09	0.296
21	4	27	0.11	0.320
21	5	29	0.14	0.351
21	6	37	0.05	0.229
21	7	29	0.00	0.000
21	8	33	0.00	0.000
21	9	22	0.00	0.000
21	10	9	0.00	0.000
21	11	10	0.00	0.000
21	12	7	0.00	0.000

Plot	Leaves	Number	Proportion presumed dead	
			Mean	SD
21	13	3	0.00	0.000
21	14	3	0.00	0.000
21	16	1	0.00	.
21	17	2	0.00	0.000
21	18	1	0.00	.
21	29	1	0.00	.
21	44	1	0.00	.
21	45	1	0.00	.
22	-1	1	0.00	.
22	1	1	1.00	.
22	2	6	0.17	0.408
22	3	5	0.40	0.548
22	4	5	0.40	0.548
22	5	3	0.00	0.000
22	6	3	0.00	0.000
22	7	4	0.25	0.500
22	8	1	0.00	.
22	9	1	0.00	.
22	10	2	0.00	0.000
22	12	2	0.00	0.000
23	-1	28	0.00	0.000
23	0	3	0.00	0.000
23	1	44	0.02	0.151
23	2	98	0.00	0.000
23	3	60	0.00	0.000
23	4	38	0.00	0.000
23	5	28	0.00	0.000
23	6	11	0.00	0.000
23	7	9	0.00	0.000
23	8	2	0.00	0.000
23	9	2	0.00	0.000

Proportion of plants presumed dead.
Values represent means and standard deviations
determined across plots by the average number of leaves.

Leaves	Proportion presumed dead		
	N	Mean	SD
-1	21	0.00	0.000
0	6	0.21	0.136
1	18	0.14	0.074
2	21	0.07	0.016
3	21	0.11	0.040
4	22	0.15	0.055
5	21	0.12	0.055
6	21	0.13	0.052
7	20	0.09	0.035
8	19	0.14	0.072
9	15	0.16	0.072
10	11	0.15	0.097
11	8	0.11	0.085
12	9	0.24	0.144
13	3	0.67	0.333
14	3	0.00	0.000
16	1	0.00	.
17	1	0.00	.
18	1	0.00	.
29	1	0.00	.
44	1	0.00	.
45	1	0.00	.

Proportion of plants presumed dead.
Values represent means and standard deviations
determined across plants mapped within a plot.

Plot	Proportion presumed dead		
	N	Mean	SD
1	381	0.02	0.007
2	405	0.08	0.014
3	149	0.07	0.021
4	263	0.13	0.020
5	8	0.13	0.125
6	821	0.04	0.007
7	391	0.07	0.013
8	514	0.07	0.012
9	12	0.33	0.142
10	20	0.05	0.050
11	84	0.00	0.000

Plot	Proportion presumed dead		
	N	Mean	SD
12	206	0.00	0.005
14	488	0.02	0.007
15	28	0.14	0.067
16	332	0.07	0.014
17	48	0.00	0.000
18	65	0.29	0.057
19	26	0.50	0.100
20	644	0.02	0.005
21	338	0.04	0.011
22	34	0.21	0.070
23	323	0.00	0.003

Proportion of mapped plants presumed dead.
Values represent means and standard deviations
determined across plots and plants mapped within a plot.

Proportion presumed dead		
N	Mean	Standard Error
22	0.10	0.027

Appendix F: Disturbance, Density, and Vegetation Associates for Purple Amole

Mean values of density of purple amole, change in density from the previous year to the current, and animal and human-related disturbances sorted by plot and years.

Plot	Year	N	Density	Change in density	Animal	Human	Total Dist	Gopher	Multi-animal	Vehicle	Multi-human	Fire	Road
1	2000	21	4.3	2.6	0.29	0.05	0.33	0.29	0.00	0.00	0.00	0.00	0.05
1	2001	21	5.3	1.0	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00
1	2002	21	4.1	-1.2	0.48	0.14	0.52	0.48	0.00	0.14	0.00	0.00	0.00
1	2003	21	4.8	0.7	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00
1	2004	21	4.2	-0.6	0.43	0.00	0.43	0.19	0.00	0.00	0.00	0.00	0.00
2	2000	21	3.6	1.2	0.24	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00
2	2001	21	5.3	1.7	0.67	0.00	0.67	0.67	0.00	0.00	0.00	0.00	0.00
2	2002	21	9.0	3.7	0.76	0.00	0.76	0.76	0.00	0.00	0.00	0.00	0.00
2	2003	21	7.0	-2.0	0.71	0.00	0.71	0.71	0.00	0.00	0.00	0.00	0.00
2	2004	21	6.3	-0.7	0.43	0.00	0.43	0.14	0.05	0.00	0.00	0.00	0.00
3	2000	21	1.2	0.4	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
3	2001	21	1.3	0.1	0.52	0.00	0.52	0.52	0.00	0.00	0.00	0.00	0.00
3	2002	21	1.1	-0.2	0.43	0.00	0.43	0.43	0.00	0.00	0.00	0.00	0.00
3	2003	21	0.7	-0.4	0.71	0.00	0.71	0.67	0.00	0.00	0.00	0.00	0.00
3	2004	21	0.6	-0.1	0.33	0.05	0.38	0.29	0.00	0.05	0.00	0.00	0.00
4	2000	21	1.1	0.1	0.76	0.05	0.81	0.76	0.00	0.05	0.00	0.00	0.00
4	2001	21	5.0	3.8	0.86	0.00	0.86	0.86	0.00	0.00	0.00	0.00	0.00
4	2002	21	1.2	-3.8	0.90	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00
4	2003	21	8.6	7.4	1.00	0.00	1.00	0.95	0.05	0.00	0.00	0.00	0.00
4	2004	21	3.9	-4.7	0.71	0.00	0.71	0.52	0.00	0.00	0.00	0.00	0.00
5	2000	21	0.0	0.0	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
5	2001	21	0.0	0.0	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
5	2002	21	0.0	0.0	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
5	2003	21	0.0	0.0	0.76	0.00	0.76	0.76	0.00	0.00	0.00	0.00	0.00
5	2004	21	0.0	0.0	0.24	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00
6	2000	21	8.4	4.2	0.67	0.10	0.76	0.67	0.00	0.10	0.00	0.00	0.00
6	2001	21	17.7	9.2	0.29	0.05	0.33	0.29	0.00	0.05	0.00	0.00	0.00
6	2002	21	10.3	-7.3	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
6	2003	21	32.2	21.9	0.38	0.00	0.38	0.38	0.00	0.00	0.00	0.00	0.00
6	2004	21	29.4	-2.9	0.71	0.00	0.71	0.67	0.00	0.00	0.00	0.00	0.00
7	2000	21	13.1	9.5	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00

Plot	Year	N	Density	Change in density	Animal	Human	Total Dist	Gopher	Multi-animal	Vehicle	Multi-human	Fire	Road
7	2001	21	16.1	3.0	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
7	2002	21	9.0	-7.1	0.90	1.00	1.00	0.81	0.00	0.00	0.10	0.90	0.00
7	2003	21	17.8	8.8	0.48	0.00	0.48	0.43	0.00	0.00	0.00	0.00	0.00
7	2004	21	14.7	-3.1	0.62	0.05	0.67	0.48	0.05	0.05	0.00	0.00	0.00
8	2000	21	21.6	10.0	0.14	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00
8	2001	21	75.5	53.9	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00
8	2002	21	32.0	-43.5	1.00	1.00	1.00	0.95	0.05	0.00	0.00	1.00	0.00
8	2003	21	55.8	23.8	0.24	0.00	0.24	0.19	0.05	0.00	0.00	0.00	0.00
8	2004	21	41.3	-14.5	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
9	2000	21	1.5	1.0	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
9	2001	21	2.1	0.6	0.43	0.00	0.43	0.43	0.00	0.00	0.00	0.00	0.00
9	2002	21	1.1	-1.0	0.62	0.00	0.62	0.57	0.05	0.00	0.00	0.00	0.00
9	2003	21	1.4	0.3	0.57	0.00	0.57	0.57	0.00	0.00	0.00	0.00	0.00
9	2004	21	1.2	-0.1	0.48	0.00	0.48	0.29	0.00	0.00	0.00	0.00	0.00
10	2000	21	1.0	0.6	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
10	2001	21	0.9	-0.2	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
10	2002	21	0.4	-0.5	0.57	0.33	0.71	0.57	0.00	0.00	0.00	0.33	0.00
10	2003	21	0.3	-0.1	0.48	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00
10	2004	21	0.3	0.0	0.38	0.00	0.38	0.24	0.00	0.00	0.00	0.00	0.00
11	2000	21	1.0	-0.2	0.14	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00
11	2001	21	1.1	0.2	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
11	2002	21	1.3	0.1	0.57	0.14	0.71	0.57	0.00	0.14	0.00	0.00	0.00
11	2003	21	1.4	0.1	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00
11	2004	21	1.4	0.0	0.10	0.29	0.38	0.10	0.00	0.29	0.00	0.00	0.00
12	2000	21	0.6	0.3	0.00	0.24	0.24	0.00	0.00	0.24	0.00	0.00	0.00
12	2001	21	1.2	0.6	0.14	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00
12	2002	21	0.9	-0.4	0.24	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00
12	2003	21	1.0	0.2	0.24	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00
12	2004	21	1.1	0.0	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
13	2000	21	0.0	0.0	0.05	0.05	0.10	0.05	0.00	0.05	0.00	0.00	0.00
13	2001	21	0.0	0.0	0.43	0.05	0.48	0.43	0.00	0.05	0.00	0.00	0.00
13	2002	21	0.0	0.0	0.24	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00
13	2003	21	0.0	0.0	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
13	2004	21	0.0	0.0	0.29	0.00	0.29	0.19	0.00	0.00	0.00	0.00	0.00
14	2000	21	21.0	11.5	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
14	2001	21	36.8	15.8	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
14	2002	21	24.6	-12.2	0.76	0.14	0.81	0.67	0.10	0.00	0.00	0.14	0.00
14	2003	21	37.3	12.7	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
14	2004	21	31.5	-5.8	0.57	0.00	0.57	0.57	0.00	0.00	0.00	0.00	0.00
15	2000	21	0.1	0.0	0.52	0.00	0.52	0.52	0.00	0.00	0.00	0.00	0.00
15	2001	21	0.7	0.5	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
15	2002	21	1.0	0.4	0.67	0.00	0.67	0.67	0.00	0.00	0.00	0.00	0.00
15	2003	21	0.9	-0.2	0.71	0.00	0.71	0.71	0.00	0.00	0.00	0.00	0.00
15	2004	21	0.6	-0.2	0.52	0.00	0.52	0.48	0.00	0.00	0.00	0.00	0.00

Plot	Year	N	Density	Change in density	Animal	Human	Total Dist	Gopher	Multi-animal	Vehicle	Multi-human	Fire	Road
16	2000	21	4.3	2.0	0.57	0.00	0.57	0.57	0.00	0.00	0.00	0.00	0.00
16	2001	21	6.1	1.8	0.67	0.00	0.67	0.67	0.00	0.00	0.00	0.00	0.00
16	2002	21	6.9	0.8	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
16	2003	21	4.5	-2.4	0.14	0.67	0.81	0.14	0.00	0.62	0.05	0.00	0.00
16	2004	21	4.3	-0.2	0.05	0.24	0.29	0.05	0.00	0.10	0.00	0.00	0.14
17	2000	21	0.2	0.1	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
17	2001	21	0.3	0.1	0.76	0.00	0.76	0.76	0.00	0.00	0.00	0.00	0.00
17	2002	21	0.1	-0.2	0.86	0.00	0.86	0.86	0.00	0.00	0.00	0.00	0.00
17	2003	21	0.1	0.0	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
17	2004	21	0.1	0.0	0.95	0.00	0.95	0.95	0.00	0.00	0.00	0.00	0.00
18	2000	21	0.9	0.4	0.76	0.00	0.76	0.76	0.00	0.00	0.00	0.00	0.00
18	2001	21	1.0	0.1	0.90	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00
18	2002	21	0.9	-0.1	0.95	0.00	0.95	0.95	0.00	0.00	0.00	0.00	0.00
18	2003	21	1.0	0.1	0.81	0.00	0.81	0.81	0.00	0.00	0.00	0.00	0.00
18	2004	21	0.4	-0.6	0.48	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00
19	2000	21	0.2	0.2	0.48	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00
19	2001	21	0.2	0.0	0.90	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00
19	2002	21	0.1	-0.1	0.90	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.00
19	2003	21	0.2	0.1	0.48	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00
19	2004	21	0.2	0.0	0.57	0.00	0.57	0.38	0.00	0.00	0.00	0.00	0.00
20	2000	21	0.8	0.1	0.29	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00
20	2001	21	3.1	2.3	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
20	2002	21	1.8	-1.4	0.48	0.52	0.71	0.48	0.00	0.00	0.00	0.52	0.00
20	2003	21	4.6	2.8	0.48	0.00	0.48	0.48	0.00	0.00	0.00	0.00	0.00
20	2004	21	4.4	-0.2	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
21	2000	21	1.9	0.4	0.43	0.00	0.43	0.43	0.00	0.00	0.00	0.00	0.00
21	2001	21	2.8	0.9	0.57	0.00	0.57	0.57	0.00	0.00	0.00	0.00	0.00
21	2002	21	2.5	-0.3	0.71	0.00	0.71	0.71	0.00	0.00	0.00	0.00	0.00
21	2003	21	5.5	3.0	0.43	0.00	0.43	0.10	0.00	0.00	0.00	0.00	0.00
21	2004	21	4.8	-0.8	0.43	0.00	0.43	0.24	0.00	0.00	0.00	0.00	0.00
22	2000	21	0.4	0.3	0.10	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00
22	2001	21	0.3	-0.1	0.19	0.00	0.19	0.19	0.00	0.00	0.00	0.00	0.00
22	2002	21	0.3	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	2003	21	0.3	0.0	0.14	0.00	0.14	0.10	0.00	0.00	0.00	0.00	0.00
22	2004	21	0.4	0.0	0.19	0.00	0.19	0.05	0.00	0.00	0.00	0.00	0.00
23	2000	21	1.6	1.4	0.00	0.10	0.10	0.00	0.00	0.10	0.00	0.00	0.00
23	2001	21	1.9	0.3	0.05	0.05	0.10	0.05	0.00	0.00	0.00	0.00	0.05
23	2002	21	1.7	-0.2	0.19	0.10	0.19	0.14	0.05	0.10	0.00	0.00	0.00
23	2003	21	2.1	0.4	0.10	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00
23	2004	21	3.6	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean and standard error of density by plot and year.

Plot	Year	N	Density	
			Mean	SE
1	2000	21	4.3	1.78
1	2001	21	5.3	2.25
1	2002	21	4.1	1.58
1	2003	21	4.8	1.88
1	2004	21	4.2	1.77
2	2000	21	3.6	1.47
2	2001	21	5.3	1.46
2	2002	21	9.0	2.90
2	2003	21	7.0	1.73
2	2004	21	6.3	2.04
3	2000	21	1.2	0.56
3	2001	21	1.3	0.53
3	2002	21	1.1	0.53
3	2003	21	0.7	0.28
3	2004	21	0.6	0.34
4	2000	21	1.1	0.30
4	2001	21	5.0	2.10
4	2002	21	1.2	0.43
4	2003	21	8.6	3.22
4	2004	21	3.9	1.40
5	2000	21	0.0	0.00
5	2001	21	0.0	0.00
5	2002	21	0.0	0.00
5	2003	21	0.0	0.05
5	2004	21	0.0	0.05
6	2000	21	8.4	1.50
6	2001	21	17.7	2.94
6	2002	21	10.3	1.55
6	2003	21	32.2	6.21
6	2004	21	29.4	4.39
7	2000	21	13.1	3.96
7	2001	21	16.1	4.90
7	2002	21	9.0	3.12
7	2003	21	17.8	5.29
7	2004	21	14.7	4.49
8	2000	21	21.6	5.11
8	2001	21	75.5	20.91
8	2002	21	32.0	8.12
8	2003	21	55.8	14.61
8	2004	21	41.3	7.42
9	2000	21	1.5	0.73
9	2001	21	2.1	1.03
9	2002	21	1.1	0.56

Plot	Year	N	Density	
			Mean	SE
9	2003	21	1.4	0.68
9	2004	21	1.2	0.66
10	2000	21	1.0	0.63
10	2001	21	0.9	0.44
10	2002	21	0.4	0.19
10	2003	21	0.3	0.14
10	2004	21	0.3	0.21
11	2000	21	1.0	0.41
11	2001	21	1.1	0.48
11	2002	21	1.3	0.57
11	2003	21	1.4	0.56
11	2004	21	1.4	0.63
12	2000	21	0.6	0.36
12	2001	21	1.2	0.57
12	2002	21	0.9	0.54
12	2003	21	1.0	0.43
12	2004	21	1.1	0.50
13	2000	21	0.0	0.00
13	2001	21	0.0	0.00
13	2002	21	0.0	0.00
13	2003	21	0.0	0.00
13	2004	21	0.0	0.00
14	2000	21	21.0	5.17
14	2001	21	36.8	11.16
14	2002	21	24.6	6.14
14	2003	21	37.3	9.75
14	2004	21	31.5	8.75
15	2000	21	0.1	0.10
15	2001	21	0.7	0.25
15	2002	21	1.0	0.58
15	2003	21	0.9	0.59
15	2004	21	0.6	0.34
16	2000	21	4.3	1.58
16	2001	21	6.1	2.60
16	2002	21	6.9	2.75
16	2003	21	4.5	2.02
16	2004	21	4.3	1.62
17	2000	21	0.2	0.19
17	2001	21	0.3	0.29
17	2002	21	0.1	0.10
17	2003	21	0.1	0.14
17	2004	21	0.1	0.14
18	2000	21	0.9	0.34

Plot	Year	N	Density	
			Mean	SE
18	2001	21	1.0	0.50
18	2002	21	0.9	0.44
18	2003	21	1.0	0.57
18	2004	21	0.4	0.19
19	2000	21	0.2	0.09
19	2001	21	0.2	0.15
19	2002	21	0.1	0.08
19	2003	21	0.2	0.14
19	2004	21	0.2	0.15
20	2000	21	0.8	0.62
20	2001	21	3.1	1.32
20	2002	21	1.8	0.93
20	2003	21	4.6	2.09
20	2004	21	4.4	1.95
21	2000	21	1.9	0.81
21	2001	21	2.8	1.03
21	2002	21	2.5	1.11
21	2003	21	5.5	2.79
21	2004	21	4.8	2.58
22	2000	21	0.4	0.38
22	2001	21	0.3	0.29
22	2002	21	0.3	0.29
22	2003	21	0.3	0.29
22	2004	21	0.4	0.33
23	2000	21	1.6	0.85
23	2001	21	1.9	1.03
23	2002	21	1.7	1.02
23	2003	21	2.1	1.33
23	2004	21	3.6	1.88

Mean density of purple amole, percentage cover of total herbaceous species, native species, nonnative species, bare ground, gopher disturbance, pests, and presence of biological soil crusts by plot and year.

Plot	Year	Total	Native	Non-native	Bare ground	Gopher	Pest	Density			Crusts
								Total	Reprod	Veg	
1	2000	26.5	12	5	2.5	5	2.5	0.6	0	0.6	.
1	2001	43	29	9.5	26	2.5	2.5	0.8	0	0.8	.
1	2002	29	35.5	50	59.5	5	5	0.8	0	0.8	0.6
1	2003	69	24	87.5	19	2.5	2.5	0.8	0	0.8	0.6
1	2004	73.5	7.5	19.5	12	2.5	2.5	0.8	0	0.8	0.6
2	2000	97.5	30.8	65.8	2.5	2.5	2.5	0.2	0	0.2	.
2	2001	37.5	28.5	15	33	2.5	5	0.2	0	0.2	.
2	2002	87.5	47	53	12.5	2.5	15	0.4	0	0.4	1
2	2003	92.5	10	87.5	2.5	2.5	2.5	0.4	0.2	0.2	0.8
2	2004	97.5	17	33	2.5	5	2.5	0	0	0	0.2
3	2000	59	10	45	9.5	2.5	2.5	0.8	0.8	0	.
3	2001	52.5	7.5	29	40.5	2.5	2.5	0.6	0.4	0.2	.
3	2002	85.5	12	76	19.5	2.5	14.5	0.8	0	0.8	0.6
3	2003	69	14.5	88	24.5	5	7.5	0.2	0.2	0	0.8
3	2004	85.5	14.5	76	14.5	2.5	2.5	0.2	0.2	0	1
4	2000	52	12.5	24	12	19.5	2.5	0.2	0.2	0	.
4	2001	61.5	43	26	7.5	19	19	0.6	0.2	0.4	.
4	2002	73.5	33	57	50	38	14.5	0	0	0	0.8
4	2003	83	5	95	12	2.5	5	2.2	0	2.2	0.8
4	2004	78.5	5	54.5	14.5	2.5	2.5	0.8	0	0.8	0.4
5	2000	78.5	2.5	64	19	7.5	2.5	0	0	0	.
5	2001	57	52.5	5	26.5	5	2.5	0	0	0	.
5	2002	52.5	52.5	10	28.5	5	2.5	0	0	0	0.8
5	2003	68.5	2.5	97.5	31.5	7.5	2.5	0	0	0	0.4
5	2004	73.5	2.5	92.5	17	2.5	2.5	0	0	0	0.4
6	2000	28.5	9.5	21.5	47.5	2.5	2.5	1	0.8	0.2	.
6	2001	43.75	31.9	11.25	35	5.625	2.5	2.8	0.6	2.2	.
6	2002	47.5	33	42.5	57.5	24	2.5	1.4	0.6	0.8	0.2
6	2003	66.5	33	67	33.5	14.5	5	4.6	0.6	4	0.6
6	2004	85	31.9	44.4	5.625	2.5	2.5	5	0	5	0.6
7	2000	88	24	62	5	2.5	2.5	4.6	2	2.6	.
7	2001	67	29	28.5	24	5	2.5	1.8	0	1.8	.
7	2002	69	36	26.5	69	14.5	16.5	0.8	0	0.8	0.2
7	2003	85.5	19	81	14.5	2.5	2.5	1.2	0	1.2	0.4
7	2004	85.5	19.5	76	2.5	10	2.5	0.4	0	0.4	0
8	2000	80.5	45	14.5	9.5	2.5	2.5	5.8	2.4	3.4	.
8	2001	80.5	19.5	47.5	10	2.5	2.5	12.6	2.6	10	.
8	2002	75.5	43	33.5	80.5	5	7.5	9.4	0	9.4	0.2
8	2003	97.5	15	67	2.5	2.5	2.5	15	0.8	14.2	1
8	2004	88	26.5	33.5	9.5	2.5	2.5	10.6	0.2	10.4	0.6
9	2000	64.5	38	19	5	2.5	2.5	0	0	0	.

Plot	Year	Total	Native	Non-native	Bare ground	Gopher	Pest	Density			Crusts
								Total	Reprod	Veg	
9	2001	69	35.5	33.5	9.5	2.5	2.5	0	0	0	.
9	2002	64	33.5	50	80.5	5	2.5	0	0	0	0
9	2003	85.5	21.5	78.5	14.5	2.5	2.5	0	0	0	0.2
9	2004	78.5	14.5	73.5	14.5	2.5	2.5	0	0	0	0
10	2000	64	10	35.5	28.5	2.5	2.5	0	0	0	.
10	2001	50	7.5	40.5	28.5	5	2.5	0.2	0	0.2	.
10	2002	54.5	24	59.5	85	2.5	2.5	0	0	0	0.6
10	2003	74	14.5	76.5	26	2.5	2.5	0	0	0	0.6
10	2004	59.5	5	43	35.5	2.5	2.5	0.2	0	0.2	0.4
11	2000	45.5	5	33.5	45	2.5	2.5	0	0	0	.
11	2001	50	38.5	7.5	42.5	2.5	2.5	0	0	0	.
11	2002	52.5	45	24	83	9.5	14.5	0	0	0	0.6
11	2003	78	5	95	17	2.5	2.5	0	0	0	0.4
11	2004	80.5	5	88	12	2.5	2.5	0	0	0	1
12	2000	38.75	14.375	17.5	5.625	2.5	2.5	0.2	0.2	0	.
12	2001	74	5	64.5	10	2.5	2.5	0.2	0	0.2	.
12	2002	59.5	10	67	59.5	2.5	2.5	0.2	0	0.2	0
12	2003	76	19.5	85.5	21.5	2.5	5	0.2	0.2	0	0.6
12	2004	87.5	14.5	85.5	12	2.5	2.5	0.2	0	0.2	0
13	2000	36	10	7.5	29	2.5	2.5	0	0	0	.
13	2001	45.5	19	26	50	2.5	2.5	0	0	0	.
13	2002	59.5	38	43	85	2.5	5	0	0	0	0.8
13	2003	64.5	10	61.5	21.5	2.5	21.5	0	0	0	0.4
13	2004	62	19.5	38	9.5	2.5	2.5	0	0	0	0.4
14	2000	66	17	24	21.5	2.5	2.5	8.6	1.2	7.4	.
14	2001	43	33.5	5	38.5	2.5	2.5	12.8	1.4	11.4	.
14	2002	43	43	33.5	85	2.5	2.5	7.4	0	7.4	1
14	2003	47.5	33	52	37.5	2.5	2.5	11.8	0.6	11.2	1
14	2004	52.5	28.5	47.5	33	38	2.5	9.2	0.4	8.8	1
15	2000	64	7.5	47.5	7.5	5	5	0	0	0	.
15	2001	76.5	45.5	43	2.5	7.5	5	0	0	0	.
15	2002	92.5	21.5	73.5	7.5	5	12.5	0	0	0	0.4
15	2003	85	33.5	61.5	15	5	5	0	0	0	0.6
15	2004	80.5	33.5	61.5	2.5	5	2.5	0	0	0	0.4
16	2000	38	7.5	21.5	12	21.5	2.5	1.4	0.4	1	.
16	2001	38	38	2.5	31	7.5	2.5	2.2	1	1.2	.
16	2002	59	33.5	57	41	5	2.5	3.2	0	3.2	0.2
16	2003	50	10	52	40.5	2.5	2.5	1.8	0.6	1.2	0
16	2004	47.5	7.5	14.5	35.5	2.5	2.5	0.8	0.2	0.6	0.4
17	2000	38.5	16.5	12	7.5	26.5	2.5	0	0	0	.
17	2001	67.5	58.75	11.25	2.5	26.875	2.5	0	0	0	.
17	2002	78	47	45.5	19	17	17	0	0	0	0.8
17	2003	83	15	85	7.5	5	5	0	0	0	0.4

Plot	Year	Total	Native	Non-native	Bare ground	Gopher	Pest	Density			Crusts
								Total	Reprod	Veg	
17	2004	80.5	10	42.5	7.5	10	2.5	0	0	0	0.6
18	2000	29.375	11.25	11.25	20.625	20.625	2.5	0.4	0.2	0.2	.
18	2001	40.5	31	7.5	24	26	2.5	0	0	0	.
18	2002	64	33	67	40.5	5	22	0	0	0	1
18	2003	61.5	24.5	62	19.5	10	2.5	0	0	0	0.8
18	2004	71	33	57.5	14.5	7.5	2.5	0	0	0	1
19	2000	68.5	5	61.5	12	5	2.5	0	0	0	.
19	2001	87.5	12	80.5	2.5	5	2.5	0	0	0	.
19	2002	83	21.5	61.5	71	12	12	0	0	0	0.2
19	2003	97.5	2.5	97.5	2.5	2.5	2.5	0	0	0	0.4
19	2004	97.5	5	95	2.5	2.5	12	0	0	0	0.2
20	2000	71	2.5	73.5	7.5	2.5	2.5	0	0	0	.
20	2001	97.5	2.5	85	2.5	2.5	2.5	0.2	0	0.2	.
20	2002	48	12	71	75.5	9.5	2.5	0.2	0	0.2	0.4
20	2003	88	5	80.5	7.5	2.5	5	1	0	1	0.8
20	2004	95	2.5	75.5	5	2.5	2.5	1	0	1	0.2
21	2000	61.5	10	54.5	14.5	12	5	1.2	1	0.2	.
21	2001	71	36	35.5	10	5	2.5	1.2	0.4	0.8	.
21	2002	62	36	47.5	64	21.5	2.5	1.2	1	0.2	0.4
21	2003	95	35.5	62.5	5	2.5	2.5	2.6	0.8	1.8	0.2
21	2004	78.5	5	71	5	2.5	2.5	2.2	1	1.2	0.2
22	2000	95	12	66	2.5	2.5	2.5	0	0	0	.
22	2001	95	12	92.5	5	2.5	2.5	0	0	0	.
22	2002	95	14.5	66.5	85	2.5	2.5	0	0	0	0
22	2003	97.5	2.5	97.5	2.5	2.5	2.5	0	0	0	0.6
22	2004	97.5	5	92.5	2.5	2.5	2.5	0	0	0	0
23	2000	19.5	2.5	9.5	28.5	2.5	2.5	0	0	0	.
23	2001	15	11.875	15	68.125	2.5	2.5	0	0	0	.
23	2002	33	26.5	52.5	85	2.5	2.5	0	0	0	0.6
23	2003	52	28.5	62	48	2.5	2.5	0	0	0	0.6
23	2004	66.5	10	29	9.5	2.5	2.5	0.2	0	0.2	0.6

Percentage cover and SEM by years of total herbaceous species, native species, non-native species, bare ground, gopher disturbance, pest disturbance, and the proportion of non-mapped quadrats with biological soil crusts present.

Year	N	Total herbaceous species		Native species		Non-native species		Bare ground		Gopher disturbance		Pest disturbance		Presence of crusts	
		Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
2000	23	57.0	4.70	13.7	2.30	34.6	4.72	15.4	2.67	6.9	1.57	2.7	0.15	.	.
2001	23	59.3	4.28	27.3	3.27	31.4	5.60	23.0	3.72	6.4	1.51	3.4	0.72	.	.
2002	23	63.8	3.76	31.8	2.54	50.8	3.54	58.4	5.46	8.7	1.87	8.0	1.34	0.50	0.069
2003	23	76.8	3.20	16.7	2.28	77.4	3.14	18.5	2.73	3.9	0.63	4.2	0.84	0.57	0.053
2004	23	78.3	2.88	14.0	2.16	58.4	5.14	12.1	2.10	5.1	1.57	2.9	0.41	0.44	0.069

Appendix G: Sum of Mapped Purple Amole Plants

Sum of mapped 1- to 3-leaved plants, 4- to 8-leaved plants, and plants with 9 or more leaves by plot and year.
Values do not represent means across quadrats within a plot.

Plot	Year	1- to 3-leaved plants	4- to 8-leaved plants	9- or more-leaved plants
1	2000	16	21	0
2	2000	29	12	1
3	2000	2	9	0
4	2000	2	2	0
5	2000	0	0	0
6	2000	12	22	4
7	2000	35	39	3
8	2000	23	28	0
9	2000	0	1	1
10	2000	0	2	0
11	2000	0	3	4
12	2000	4	2	2
13	2000	0	0	0
14	2000	36	19	0
15	2000	0	0	0
16	2000	18	12	1
17	2000	2	0	0
18	2000	2	3	0
19	2000	0	1	0
20	2000	0	1	0
21	2000	5	19	2
22	2000	0	0	0
23	2000	5	8	0
1	2001	21	17	1
2	2001	29	19	2
3	2001	2	7	0
4	2001	9	5	0
5	2001	0	0	0
6	2001	51	31	6
7	2001	46	26	5
8	2001	82	34	1
9	2001	0	2	0

Plot	Year	1- to 3-leaved plants	4- to 8-leaved plants	9- or more-leaved plants
10	2001	3	1	0
11	2001	0	4	3
12	2001	5	7	0
13	2001	0	0	0
14	2001	197	91	6
15	2001	3	0	0
16	2001	49	15	1
17	2001	3	0	0
18	2001	4	2	0
19	2001	2	1	0
20	2001	16	2	0
21	2001	6	26	5
22	2001	0	0	0
23	2001	18	7	0
1	2002	15	18	0
2	2002	31	10	0
3	2002	2	7	1
4	2002	0	2	0
5	2002	0	0	0
6	2002	19	33	8
7	2002	35	21	0
8	2002	43	19	0
9	2002	0	1	0
10	2002	1	2	0
11	2002	0	3	4
12	2002	4	7	1
13	2002	0	0	0
14	2002	94	67	3
15	2002	1	2	0
16	2002	62	20	1
17	2002	1	1	0
18	2002	4	2	0
19	2002	1	0	0
20	2002	14	2	1
21	2002	6	24	7
22	2002	0	0	0
23	2002	8	10	0
1	2003	27	18	0
2	2003	32	8	0
3	2003	2	3	0
4	2003	23	12	0
5	2003	1	0	0
6	2003	130	38	8
7	2003	57	31	0

Plot	Year	1- to 3-leaved plants	4- to 8-leaved plants	9- or more-leaved plants
8	2003	74	24	0
9	2003	0	1	0
10	2003	2	1	0
11	2003	0	2	6
12	2003	5	3	1
13	2003	0	0	0
14	2003	204	84	3
15	2003	1	2	0
16	2003	31	24	0
17	2003	2	1	0
18	2003	4	2	0
19	2003	2	0	0
20	2003	32	5	1
21	2003	37	23	13
22	2003	0	0	0
23	2003	16	11	0
1	2004	29	12	0
2	2004	58	6	0
3	2004	5	4	0
4	2004	13	8	0
5	2004	1	0	0
6	2004	137	31	1
7	2004	56	29	1
8	2004	45	22	0
9	2004	0	0	0
10	2004	5	0	0
11	2004	2	5	2
12	2004	7	5	1
13	2004	0	0	0
14	2004	204	40	2
15	2004	1	4	0
16	2004	25	22	0
17	2004	2	1	0
18	2004	6	2	0
19	2004	2	1	0
20	2004	30	8	0
21	2004	35	26	11
22	2004	0	0	0
23	2004	48	3	0

Mean and SD of the number of 1- to 3-, 4- to 8-, and 9- or more-leaved plants by year. Values were determined by summing data from individual quadrats within a plot and determining their average and standard deviation across all plots by year.

Year	1- to 3-leaved plants		4- to 8-leaved plants		9- or more-leaved plants	
	Mean	SD	Mean	SD	Mean	SD
2000	8.3	11.89	8.9	10.89	0.8	1.31
2001	23.7	43.56	12.9	20.22	1.3	2.12
2002	14.8	23.91	10.9	15.48	1.1	2.26
2003	29.7	49.07	12.7	19.21	1.4	3.27
2004	30.9	49.15	10.0	12.01	0.8	2.32

Mean and SD of the number of 1- to 3-, 4- to 8-, and 9- or more-leaved plants. Values were determined by summing data from individual quadrats within a plot and determining their average and standard deviation across all plots and years.

1- to 3-leaved plants		4- to 8-leaved plants		9- or more-leaved plants	
Mean	SD	Mean	SD	Mean	SD
21.5	38.87	11.1	15.80	1.1	2.31

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14. ABSTRACT

Researchers monitored the threatened plant, purple amole (*Chlorogalum purpureum var. purpureum*) at Fort Hunter Liggett, California, from 1998 to 2004. The objectives of this research were to complete a statistical analysis of these data to evaluate: (1) demographics; (2) trends in population density; and (3) the relationship of purple amole to associated species, biological soil crusts, and disturbance. Overall, purple amole was most likely to flower and have greater seed production when it attained about 8 leaves or widths of 7 to 8 mm for its widest leaf, revealing a clear relationship between plant size and successful reproduction and seed set. Mortality and dormancy rates were estimated at 10 and 23 percent per year, respectively. Presumably, dormancy occurred, as mapped individuals were absent periodically throughout the monitoring. Density of purple amole was positively correlated with native species and presence of bio-logical soil crusts; relationships to disturbance type were not apparent. Power analyses revealed that purple amole should be monitored at least 10 years to detect increases or decreases of 10 percent for mature plants (4 or more leaves). Due to greater variability, 10 to 20 years of monitoring are recommended to detect similar changes for 1 to 3-leaved plants.

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